JUNE 1934

Engineering and Mining Journal

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European Metal Market Trends

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H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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WILLARD CHEVALIER
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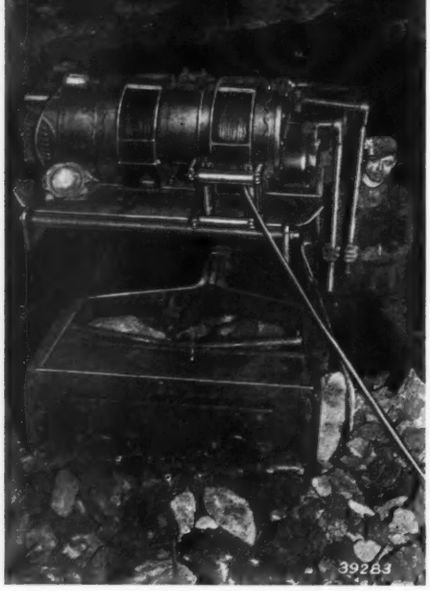

View showing end control levers for clutches and brakes.

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New York: A. H. HUBBELL, H. D. KEISER, Associate Editors
H. H. WANDERS, Market Editor; W. N. P. REED, Assistant Editor
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Washington, D. C.: PAUL WOOTON

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Silver Legislation Looms On the Congressional Horizon

DESPITE the ebb and flow of opinion on the silver question ever since a degree of international accord was reached at London last July, all signs and portents have indicated that the Roosevelt Administration would take further affirmative action looking toward the rehabilitation of silver as a monetary metal. The President's wishes have now been embodied in proposed legislation which, it is generally conceded, will be enacted by Congress.

•Press dispatches have pictured the President as giving "reluctant consent" to the "demands" of the silver bloc, but this seems rather an ingenuous distortion of the facts. In our judgment he has prevailed upon others to accept his policy of proceeding step by step in his plans to improve the domestic financial and monetary system without disturbing adjustments in world trade. First he gave his attention to gold. Now he proposes not to "neglect the value of an increased use of silver in improving our monetary system."

•Briefly, the legislation declares it to be the policy of the United States to increase the proportion of silver to gold in our monetary stocks, ultimately to one-fourth silver and three-fourths gold. To this end the Secretary of the Treasury is directed to buy silver at home or abroad under permissive conditions as to price and time most advantageous to the public interest. Not more than fifty cents an ounce will be paid for silver situated in the continental United States on May 1, 1934, and the President may require the delivery of existing domestic stocks of silver at a fair value as indicated by the market price. Speculative profits will be curbed by taxation.

•What does the Administration hope to achieve by this legislation? Aside from broadening the metallic base of our currency, the principal motive undoubtedly is to raise the world price of silver and lower the world value of gold—to use silver to cheapen gold and thus raise the prices of other commodities also. As an economic weapon in meeting world competition with the Far East, silver enhanced in price will not only be effective for the United States, but will hold direct interest for European nations, despite their reported apathy and indifference toward the Roosevelt silver policy.

•As for the mining industry, the proposed legislation may be viewed in a favorable light. Newly mined domestic silver is already priced at 64½ cents an ounce. Huge purchases of silver at an exorbitantly high price are not to be expected, nor would such a program be desirable. But a consistent program of silver purchase "at home or abroad" must inevitably enhance the price of the metal gradually, to the benefit of the mining industry. Finally, the intended economic effect of the program is a stimulus to recovery in which the mining industry should share through a more vigorous use of the metal. In short, the silver policy of the Administration as a long-time measure is not to be underrated, despite the disappointment of those who would have welcomed more radical action.

Out Where the Blue Begins

OF ALL the "literature" that constantly flows through the editorial office of a technical mining publication such as *Engineering and Mining Journal,* that relating to new discoveries, new prospects, and new ventures bulks the largest. This material, as might be expected, is almost invariably written in a vein that leads the reader to suspect the author of wearing the rosiest of rose-tinted spectacles and of heading-up the farthest left of the left-wing optimists. An account of this character, discussing the very great importance of current discoveries and operations in one of the many old districts that are being revived, was submitted recently for publication. Before putting the account in type, a check-up by correspondence with several of the operators in the district was deemed advisable. A number of the replies that were received repeated such phrases of the original account as: "the outstanding importance of new discoveries, details of which will soon be made public," and "predictions of a bright future for the district." But neither the account nor the letters presented any factual material that would be of any real interest to discerning readers.

The editorial endeavor involved in this instance was, nevertheless, not without reward, which reward we purpose to share now with our readers. It is in the form of one of the letters received in response to our inquiry, a letter in marked contrast to all the others and to the daily run-of-mail at the office. Here it is:

The Editor
Dear Sir:

I have your letter of recent date asking for a short write-up on our operations here.

Will say that we are not yet prepared to make any public statement for the reason that we are not sure about results as yet. We are in the prospective stage in a part of the U. S. that has rather an unsavory reputation in the mining world and we would therefore rather not say anything about it at this time.

We have sufficient confidence in it to spend our own money and as soon as the time arrives when we have proven results that really amount to something we will be glad to tell you about it.

Thanking you for the inquiry, we are,
Sincerely yours,

How refreshing! And we are sincere too.

Work Versus the Dole

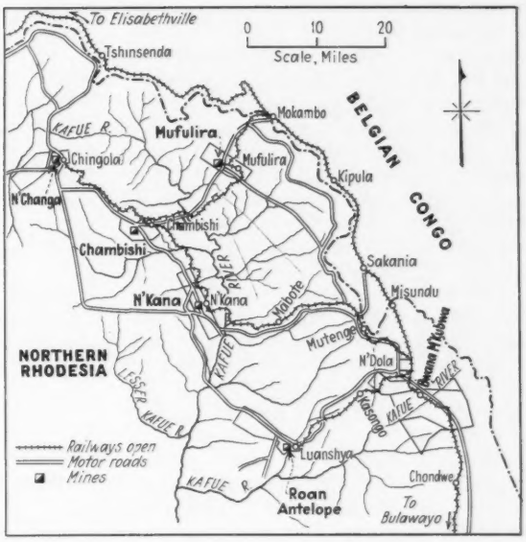
STATE MINING ENTERPRISES are better known in Australia than elsewhere in the English-speaking world. Whether this is because the people lean toward paternalism in government or because in a country having Australia's physiographic character there is a natural desire to effect the speediest development of whatever mineral resources it possesses, the answer may be left to those who delight to ponder on complexities that cry for no solution. Practically all of the mining states of the Commonwealth have in one way or other gone further along the path of direct conduct of mining and metallurgical operations for public benefit than have the mining bureaus and other agencies of government in the United States and Canada, despite the vast deal of research conducted in these countries. Here, in mining, paternalism in the past has been largely avoided. Profit-earning enterprise in the main has been left to private capital. But conditions have changed in the last few years and mining communities in need of relief have multiplied. Thus has come about the spectacle of disbursement from the public treasury, local, State, and Federal. So familiar has the subject of relief become, in all its aspects, that many have forgotten that the vast majority of citizens prefer work to a dole, even if it yields them no more than the latter. Regarding the situation from this viewpoint, some readers may find much to interest them in the so-called Moonta mining scheme, which was initiated in 1929 in South Australia by the State and Commonwealth governments to relieve unemployment in the Moonta copper district.

Briefly, the scheme, which is supervised by the Department, has involved the granting of tributes to miners on leased mineral lands in a portion of the district where the search for ore had previously been incomplete; the devising of a government-financed co-operative plan whereby the men have been receiving work at special rates, to which is added subsequently a share of the proceeds from ore produced, this after the payment of rents, royalty, and "rates" due the Crown; the provision of shaft equipment and a concentrator, after the required expense had been proved justified by preliminary work and influential metal-producing interests had approached the Department seeking Moonta concentrates for smelting at Port Kembla, with the objective of satisfying the Australian demand for copper. The scheme has worked well: 70 men, with 260 dependents, have been taken off the books of the Relief Council during the period in which it has been in force, the saving to the country in this respect being estimated at not less than £3,500 per year, to say nothing of the saving in morale. New ore reserves have been developed. The program visualizes the treatment of 15,000 tons per annum.

Promoting Non-Metallics

FORCE OF CIRCUMSTANCES brings out the resourcefulness of competent management. In periods of business slackness when normal efforts to secure new business seem ineffective, and unusual and unforeseen difficulties arise in pioneering new methods to stimulate trade and industry, expedient management will evolve an answer. An instance of this kind is shown by a new plan advanced by Johns-Manville to obtain more business than is now flowing through ordinary channels. This plan is somewhat similar in principle to that long employed in the automobile industry: financing the sale of automobiles by arranging convenient credit terms. The Johns-Manville plan, however, seems to be completely within the company, in contrast to that of the automobile industry. In brief, the Johns-Manville Million Dollar Fund for Home Improvement offers to the home owner facilities to modernize, improve, and repair his home by making convenient loans. Free estimates are given by local representatives and agencies of the company on work ranging from a new asbestos roof to decorative interior finishes. Other industries will watch with interest this innovation to expand current business and it is hoped that success will attend the effort.

Africa
And the New Era In Copper



George L. Walker

31 Ashley Road, Epsom, Surrey, England

THOUGH the companies which have developed big copper producers in Africa, particularly in Northern Rhodesia, contributed to bring about the new era in copper—that of lower costs and selling prices—they were by no means the sole cause of it. The dawn of this new era broke about twenty years ago, when the porphyries and Katanga were coming in as producers. Before that, few companies in the world were able to deliver copper to consumers at a lower cost than 9c. per pound, and the average of costs was probably well over 10c. By their activities and influence the porphyries reduced this average appreciably. But the downward trend was interrupted by the War, during which costs advanced abnormally in keeping with the abnormal conditions.

After the first post-War depression, another abnormality developed—that of rapidly falling production costs with steadily rising prices. Too many believed for far too long that such an abnormality could be made a normal condition, and the older companies, not the new ones, produced excessively and accumulated large stocks of copper. Of course, the growing surplus and the discoveries of immense deposits of exceptionally rich disseminated ores in Northern Rhodesia were already dissipating the idea that consumptive demand could not be supplied except at high prices before the crash came.

Throughout 1930-32, the existence and prospects of the Northern Rhodesia mines, and finally their demonstration of ability to produce for far lower than estimated costs, undoubtedly were exerting a sentimental influence to depress the price. But they did not begin producing on a competitive scale until two years after the crash, and no one has ever thought or suggested that their outputs or selling caused copper to fall to 5c. per pound.

A year ago the new Northern Rhodesia mines were probably about the lowest-cost producers of copper in the world; the lowest having no precious-metal byproducts. But now, though their costs are if anything even lower than a year ago, they are only among the lowest. The greatly reduced consumption in the past three years, the low prices, and the United States tariff, forced producers outside of the United States generally to find means of reducing their costs. They introduced many economies, and some of them seem to have been helped unexpectedly by currency depreciation. As a result, some authorities in London believe that 1,000,000 tons of copper could now be produced annually outside the United States at costs ranging from 6c. down probably to 4c. or less per pound.

The new mining companies of Northern Rhodesia are established, self-sustaining enterprises. They are earning fairly good profits despite still restricted production and the prevailing low price of copper. But they could not drive the other low-cost producers out of business, nor could they be driven out by them. From the beginning of productive operations they have adhered firmly to the policy of producing no more copper than would find ready sale, and they have sold every pound produced so far. They are understood to be conducting their selling on the safe and approved principle of taking the minimum of gambling chances on price fluctuations. That they are not depressing the price by their selling is clear, as most of their output is sold as blister, and the price of blister, or "standard," copper has been unusually near that of electrolytic for several months past.

▼ ▼ ▼

Huge ore reserves and lowered costs indicate a future in which producers will be less eager for high metal prices, but will seek to sell the maximum tonnage possible at levels that will return reasonable profits—this in the absence of a demand that will increase faster than output capacities can be raised to satisfy it.

In the Rhodesia-Katanga district, which comprises small adjoining portions of Northern Rhodesia and the Belgian Congo, there is evidently several times as much copper as has been found in any other like area. All the deposits are large enough to permit their mining by economical methods. The ores are exceptionally rich, and most of them yield readily to the simplest treatment processes.

So far 551,780,000 short tons of 4.08 per cent ore has been proved in Northern Rhodesia and 85,979,000 tons of 6.41 per cent in the Belgian Congo. These are averages, of course, some ores being richer than others. The total in the district is thus 637,759,000 tons of ore containing 28,188,700 short tons of copper. All other mines of the world reporting their reserves have a total of 2,901,483,832 tons of ore averaging 1.51 per cent and containing 45,853,000 tons of copper. How much more ore or copper is to be found in the Rhodesia-Katanga district can only be guessed, but the guess should be in very big figures.

The three companies producing in Northern Rhodesia—Rhokana Corporation, Roan Antelope, and Mufulira Copper—have concentrators which were designed to treat 7,000 tons, 6,000 tons, and 1,500 tons of ore daily, respectively. This would have meant the treatment of approximately 5,000,000 short tons of

ore annually by the three companies and a combined production of about 135,000 long tons of copper. Careful designing and the favorable character of the ores, however, gave the concentrators a much larger capacity than expected, and this has been still further increased by subsequent slight alterations. The result is that with only about 60 per cent of capacity in operation, the three mills are turning out concentrates for the production of nearly 125,000 long tons of copper annually. Of course, this means that by operating their plants at full capacity the Northern Rhodesia companies could produce over 200,000 long tons of copper a year. This may be taken to be their total present productive capacity.

The only construction under way at present is the erection of an electrolytic refinery by the Rhokana Corporation, of 35,000 long tons' annual capacity adjourning its smelter at N'Kana, and the installation of a second reverberatory furnace by Roan Antelope. Neither of these can be taken to indicate an intention to increase production immediately.

Mufulira's productive capacity is to be increased sufficiently to permit of economic operations. The original plan was to erect a 5,000-ton daily capacity concentrator at Mufulira. After much of the work had been done, it was decided to complete only one section of 1,500 tons' daily capacity, and this small milling unit was attached to a 10,000-ton daily capacity mine. The funds are now being provided to complete the construction, the concentrator to have a capacity to treat 2,000,000 tons of ore annually. A smelter to handle the concentrates will be erected also. The plant is expected to have a productive capacity of 70,000 long tons of copper annually. When it is operated at half capacity it should have as low a production cost as Roan Antelope or Rhokana. This will increase the total productive capacity of Northern Rhodesia to near 300,000 long tons of copper a year.

Union Minière du Haut-Katanga, the Belgian Congo producer, has an output capacity of probably 200,000 long tons annually, and this could be increased appreciably by completing the additional plants which were in construction and planned before the crash came. At last accounts it was producing at the rate of 80,000 metric tons annually. As Union Minière pays all operating expenses in a currency which is still on the gold basis, and also receives final payment for its copper at its gold price (say 60 to 65 per cent of the American price), its profits necessarily must be rather small at present, despite its low production cost.

Cost of Production

Exchange fluctuations make it as difficult to state the cost of producing copper in cents as to determine the length of a piece of string by measuring it with an elastic tape. The sterling cost of Northern Rhodesia copper, including freight, selling, and all other expenses in Africa and England, but excluding bond interest, depreciation, and taxes, is about £22 per long ton. This means blister copper, Roan Antelope's highly pure product being sold in that form. Much of the other production is probably sold as blister also, because of the narrow margin between electrolytic and standard prices.

The cost given includes royalties paid on production by the Northern Rhodesia companies. These royalties, being a consideration attendant upon the companies having acquired their properties by grant, should be considered in the nature of depletion payments, so far as they go.

A final test of costs is to check them by profits. In the December quarter, when the price of standard copper in London averaged £31 18s. 4d. per long ton, Roan Antelope's gross income was £474,910, and its operating profit was £156,780, or about one-third of its income. This confirms the estimate of £22 as the cost. After debenture interest of £22,500 and a reserve of £37,500 for depreciation, a net profit of £96,780 remained. This means that Roan Antelope is earning at the rate of nearly $2,000,000 a year, in excess of $450,000 for bond interest and an allowance of $750,000 for depreciation, when operating at less than 60 per cent of capacity and selling its blister copper at the prices that grade brings when electrolytic is 8c. per pound.

Exploration, prospecting, and geological mapping on a large scale seem to have proved that the copper possibilities of central Africa are chiefly, if not almost wholly, confined to an area of some 70,000 square miles, which embraces the Katanga and the new mines in Northern Rhodesia. The deposits being worked in the Katanga are in the upper, and those of Rhodesia in the lower, beds of the same geological formation. Disseminated deposits of the Rhodesian type occur between the Katanga mines and the Northern Rhodesia border, and a company associated with Union Minière is drilling in the area and finding 4 per cent and better sulphide ore.

Rhokana Corporation is still conducting some prospecting and geological work to fulfill the conditions under which its vast concessions are held. Similarly, a limited amount of exploration is in progress on the Loangwa and the Rhodesia Mineral concessions. In the areas controlled by these three companies a total of 10,572 square miles was mapped last year, making to date about 130,000 square miles prospected and geologically mapped, and leaving about 46,000 square miles to be traversed. Those doing this work presumably hope more for discoveries of other metals than copper.

Table I—Companies, Ore Tonnages, and Grades

	Tonnage Proved	Per Cent Copper
Rhokana Corporation, Ltd.:		
N'Kana Mine	127,000,000	4.00
N'Changa Upper Horizon	93,000,000	3.51
N'Changa-West Lower Horizon	46,500,000	6.90
N'Changa River Lode	2,280,000	4.20
Chingola	2,000,000	7.00
Roan Antelope Copper Mines, Ltd.:		
Roan Antelope-Reitbok orebody	108,000,000	3.44
Mufulira Copper Mines, Ltd.:		
Mufulira orebody	116,000,000	4.41
Chambishi orebody	25,000,000	3.46
Baluba orebody	21,000,000	3.47
Rhodesia-Katanga Company, Ltd.:		
Kansanshi Mine	11,000,000	4.34

Table II—Divisions of N'Kana Deposit

	Short Tons of Ore	Average Grade %
North orebody	45,000,000	4.60
South orebody	15,000,000	2.95
Mindola orebody	67,000,000	3.80

Important Ore Deposits

The three producing companies have no reason to hunt for more copper ores, as they can add to their proved tonnages whenever they wish by resuming drilling, none of their deposits having been delimited. Ten important ore developments have occurred in Northern Rhodesia, all of which are in seven deposits. N'Changa, N'Changa-West, and the River Lode are the same deposit, and Baluba is on an extension of the Roan Antelope-Reitbok orebody into Mufulira territory. The names of the companies owning the proved ores, the tonnages, and the grades indicated by sampling drill cores, are given in Table I.

Underground development has shown generally that the ore beds are as wide and as high in grade as calculations from drill cores indicated.

The N'Kana deposit is apparently of huge dimensions. It was drilled approximately 9 miles along its strike, and only two short breaks were found in the mineralization. The ore is about 30 ft. thick; it dips to great depth, and it is known that it turns up again to form a syncline. Drilling to prove tonnage at considerable depths became expensive. For this reason, and because an abundance had already been proved, drilling was suspended. The N'Kana orebody has been arbitrarily divided as shown in Table II.

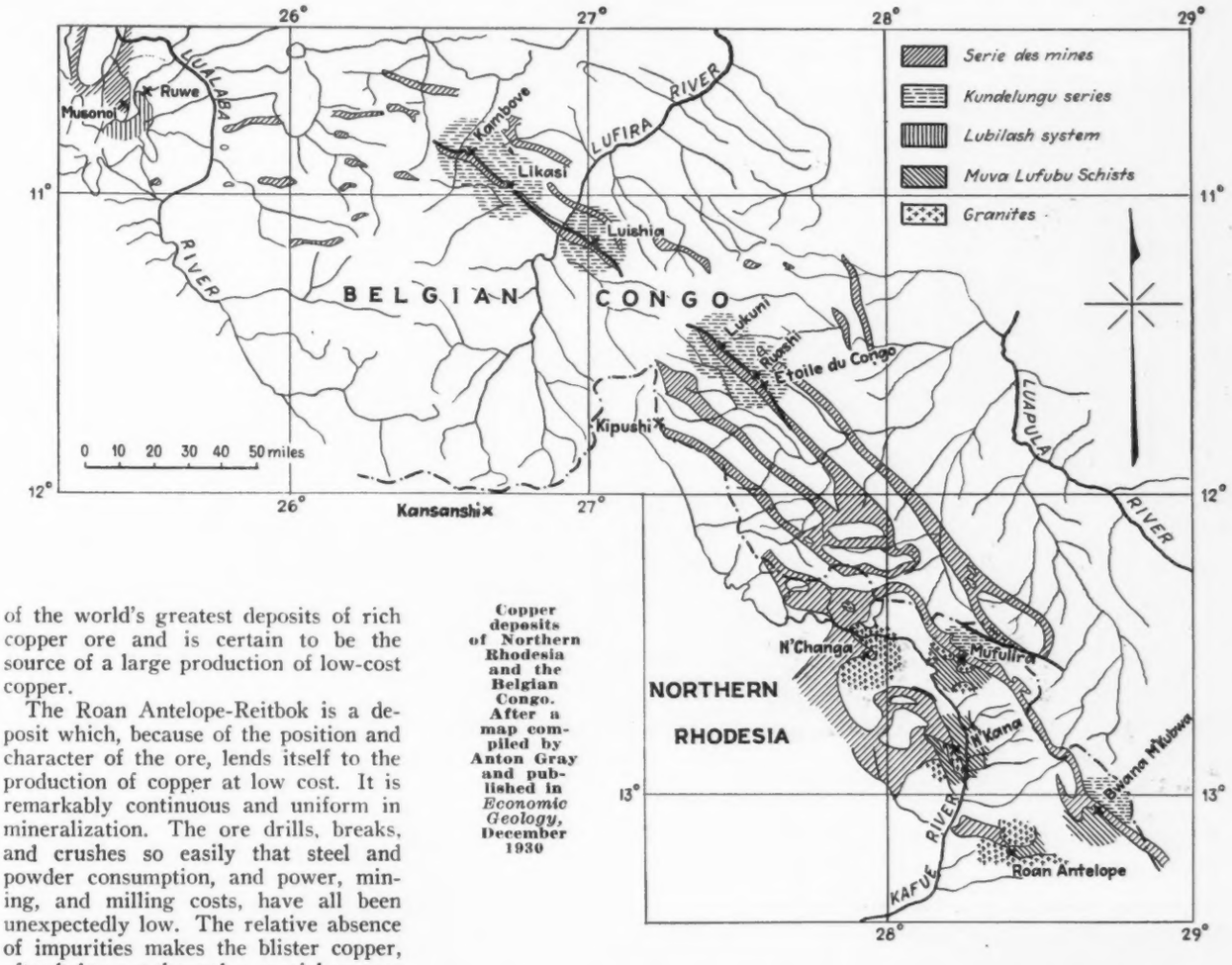
The main shaft is near the center of the North orebody. Development has revealed a continuous band of ore there over a selected width of 19.36 ft. averaging 5.77 per cent copper. Another shaft is being opened on the Mindola orebody. During the year to June 30 last 1,370,232 tons milled averaged 4.659 per cent, 0.33 per cent being in oxides, and 83.26 per cent of all the copper was recovered in concentrate averaging 54.96 per cent. Cobalt is being recovered in smelting. It is necessary to treat part of the blister by electrolysis.

The three N'Changa deposits are not

being worked, their development and exploitation being deferred pending a greater demand for copper. It may be doubted that the Upper Horizon orebody will be worked by the present generation, as it is an infusion of oxides and silicates together with 2.25 per cent of copper in sulphides. An abundance of far better ore is and will be available. The N'Changa-West orebody contains 6,300,000 tons of 17 per cent ore which could be mined selectively. This is included in the 46,500,000 tons averaging 6.9 per cent. Though N'Changa-West ore cannot be mined cheaply, and its mixed sulphide-oxide character will call for special treatment, it is definitely one of the world's greatest deposits of rich copper ore and is certain to be the source of a large production of low-cost copper.

The Roan Antelope-Reitbok is a deposit which, because of the position and character of the ore, lends itself to the production of copper at low cost. It is remarkably continuous and uniform in mineralization. The ore drills, breaks, and crushes so easily that steel and powder consumption, and power, mining, and milling costs, have all been unexpectedly low. The relative absence of impurities makes the blister copper, after being put through a special process of fire refining, the virtual equal of electrolytic. This orebody has two outcrops from which it dips to unite at depths varying from less than 1,000 ft. near the east end to approximately 2,400 ft. farther west. The bed averages about 24 ft. thick, and the values diminish close to the hanging wall in such a manner that to a certain extent lower-grade ore, instead of waste, mixes with the richer ore in mining. Drilling has proved the bed for a length of 6 miles, and an additional 3½ miles remains to be drilled, which, because of the far greater width of the syncline there, may easily double the company's ore tonnage. Mining is now confined largely to the upper levels in the east end of the deposit, and the ore milled contains 0.48 per cent of copper in oxides. Of the copper in sulphides 85.53 per cent was recovered last year, this being 75.55 per cent of the total copper in average 3.61 per cent ore. As mining gets deeper, away from the oxidized zone, the recovery should improve greatly.

The Mufulira deposit is in three adjacent beds which in places apparently merge into two. Except near the outcrops the copper is wholly in sulphide minerals. Some geologists who have studied it declare their belief that the 116,000,000 tons of 4.41 per cent ore already proved is merely one end of what will turn out to be the largest deposit of copper ever discovered. How large it is will be left for future determination, drilling having been suspended after sufficient ore to supply a mill of 5,000 tons' daily capacity for 66 years had been proved. The deepest drill hole passes through 51.5 ft. of 4.04 per cent ore, at a depth of 3,300 ft. As the average width of the ore in the three beds is approximately 90 ft., it should be possible to increase the tonnage there very rapidly whenever desired.

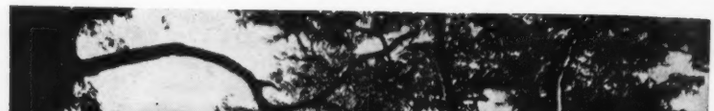


Copper deposits of Northern Rhodesia and the Belgian Congo. After a map compiled by Anton Gray and published in *Economic Geology*, December 1930

Mufulira's Chambishi deposit is of varying widths, averaging about 28 ft. The surface oxides give way to sulphides at a depth of about 300 ft. There is a band of ore on the footwall which contains 3,000,000 tons averaging 8.95 per cent copper. The ore is apparently similar to that of Roan Antelope in its freedom from impurities. Chambishi is connected by rail with Mufulira and N'Kana. The Baluba is, as stated, a part of and similar to the Roan Antelope deposit.

Twenty-two grants, in the N'Kana Concession, comprising together 149,684 acres, formerly owned by Rhodesian Selection Trust, Ltd., and Bwana M'Kubwa Copper Mining Company, Ltd., were turned over to Mufulira Copper Mines, Ltd., in exchange for Mufulira shares. These grants had been located so as to cover the known occurrences of the Roan ore-bearing formation in the N'Kana Concession. Some of them, other than Mufulira, Chambishi, and Baluba, are known to contain ore deposits, and all are good prospects. Drilling will probably be resumed on these grants after the demand for copper increases.

Located about 100 miles west from the properties described in the foregoing



Manager's residence, Roan Antelope Copper Mines, Ltd., Luanshya, Northern Rhodesia

Diamond drilling old workings, Kansanshi Mine, Northern Rhodesia

Katanga's Ruashi Mine, Belgian Congo

Road building between N'Dola and N'Kana, Northern Rhodesia

Roan Antelope recreation club, Luanshya

is the Kansanshi mine. Its deposit is of the Katanga type, consisting of replacement beds in dolomite or limestone and numerous rich veins of mixed oxide and sulphide ore, the copper being associated with gold. Platinum also has been found. The statement has been made that the 11,000,000 tons of proved ore at Kansanshi contains 200,000 oz. of gold. This property will be supplied with a railway and reduction plant when general conditions justify the investment required.

Mode of Operation

Mining is conducted in Northern Rhodesia in much the same way in many respects as elsewhere, the maximum of mechanical equipment being employed. Visitors find it different in that the ore is hoisted from shafts in a relatively level upland forested country, and dumped into mills which stand at the shafts, and adjoining which are the smelters. In the mines very little selective stoping is done, the ore being mined as it comes, as slices are cut from a loaf of bread, the uniformity of mineralization permitting this.

From the first the mining companies recognized the need of giving every attention to the comfort and health of their employees, and the greatness of the ore deposits caused them to avoid everything of the nature of temporary expedients in their planning. They built comfortable, even elaborate, camps for their white employees, and, in cooperation with them, provided recreation clubs, golf courses, football fields, tennis courts, and other facilities for play and diversion.

Competent staffs of doctors and nurses were installed in well-appointed hospitals to make certain that ill-health and accidents would be cared for promptly. Water-treatment plants were provided to insure an ample and continuous supply of sterilized water. By draining every wet spot in the vicinity of the mines and giving constant attention to the breeding places for mosquitoes, malaria was practically abolished. In all these respects the companies seem to have spared no expense.

Native Labor

In common with other industrial enterprises in Africa, as elsewhere, by far the greater number of the employees are natives. To develop and equip very large mines in Northern Rhodesia entailed at first a somewhat complicated labor problem. Would it be possible to induce the natives to leave their homes in the bush in sufficient numbers to supply the labor requirements of such big undertakings? Could their prejudice against working underground and in the dark be overcome? Once at the mines, could they be induced to stay there sufficiently long to make their training worth while?

The several features of the native labor problem soon vanished. As natives came and gained experience at the mines they spread the word through their villages that the treatment, wages, and food received were most satisfactory, and others were soon coming in great and constantly increasing numbers. They are now displaying a growing disposition to make their homes permanently at the mines.

That the natives had not had enough to eat before coming to the mines early became evident, inasmuch as soon after they had been on the regular rations provided by the companies their physical condition and strength noticeably improved. The food supplied them is the best quality of that which they had been in the habit of eating, and an abundance of it is provided. Good comfortable houses were erected for them, schools provided for their children, open-air motion picture shows given in their compounds, and medical attendance and everything else supplied that would improve their health, make them contented, and help them to become civilized.

The natives have proved adaptable, learning quickly to run machine drills and perform other mechanical tasks. By seeming prediliction, they become strongly attached to their bosses. "My Bwana," as the boss is called, is soon a best friend—a leader the native is eager to follow, work for, and please.

Control of Rhodesian Copper

Control of Rhokana Corporation is in the hands of two groups: Rhodesian Anglo American, Ltd. (which is associated with Anglo American Corporation of South Africa), and Bwana M'Kubwa Copper mining interests; and Rothschild and Rio Tinto interests. It has been stated authoritatively that Rhodesian Anglo American directly and indirectly owns over half the share capital of Rhokana; but Rio Tinto and the Rothschilds, directly and through their ownership of Minerals Separation, Ltd., probably have enough Rhokana "A" shares (each with twenty votes) to exercise voting control.

American Metal Company, Ltd., and the A. Chester Beatty interests control Roan Antelope and Rhodesian Selection Trust. It is now a matter of record that American Metal owns 70.9 per cent of Rhodesian Selection Trust's debentures and 54.2 per cent of its share capital. In addition it owns 36.19 per cent of Roan Antelope's issued shares.

Rhodesian Selection Trust owns 64.07 per cent of Mufulira Copper Mines, Ltd. This with 32.30 per cent owned by Rhokana Corporation, and the 3.63 per cent held by British South Africa Company, makes up the entire share capital of Mufulira, none being owned by the public. But ownership of the shares of Rhokana Corporation, Roan Antelope, and Rhodesian Selection Trust is more or less widely distributed.

The mines of the Rhodesia-Katanga region are evidently destined to produce a constantly increasing proportion of the world's copper supply. The great productive power of Union Minière du Haut-Katanga has long been known. And now across the border from that property, in a part of Northern Rhodesia which was almost unexplored till eight or nine years ago, ore deposits have been found, proved, developed, and mines equipped which already can produce considerably more copper annually than the Katanga ever did. That this new productive capacity was created in much less time than almost anyone would have believed to be possible is very significant.

Present Possibilities

This region, including Katanga, can now produce over 20 per cent of the greatest copper tonnage ever consumed in any single year. Two years hence it may be 25 per cent, and even then the great ore resources will be calling for further expansion of plant capacity by every one of the producing companies. Northern Rhodesia's long outcrops make expansion of ore output merely a matter of sinking and equipping additional shafts, or of opening ventilating shafts and extending underground haulage. The capacity of existing plants could be increased quickly, and the ore to feed such extensions could be made ready for stoping in those wide beds with equal rapidity.

The important fact is that more copper exists in the proved ore reserves of the Rhodesia-Katanga district than in the total reported ore reserves of either North America or South America. Of course that copper seeks a market. To sell it, consumption must be encouraged. The most certain way to encourage consumption is to make copper cheaper than the other metals which compete in its fields of use. Because of this, one may reasonably expect that the African and other low-cost producers will strive to prevent the price going high enough to retard the growth of consumption of the metal.

Looking Ahead

The new era into which the copper-producing industry has entered probably will be characterized by diminished eagerness for high metal prices. Producers will endeavor to sell the greatest tonnage of copper possible for prices which will yield reasonable business profits. In view of the condition which has been outlined, any expectation of a return to high prices must be based on the assumption that demand will absorb the existing surplus stocks and take up the slack in productive activities sooner than it will be possible for the low-cost producers to expand their existing output capacities.

The new Yuba dredge, operated by Hoyt C. Perring, near Avon, Mont. It is of sectionalized construction, the hull being built of 28 steel pontoons bolted together

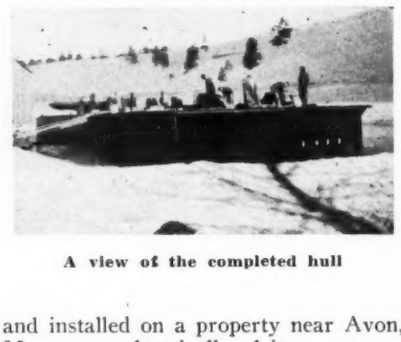
Small Placers to Benefit From Dredge Improvement

Sectionalized Hull Construction Makes Dismantling and Re-erection Cheaper

C. M. Romanowitz and G. J. Young

YEARS AGO, sectionalized machinery could be purchased in the mining equipment market. Rock crushers, stamp mills, and the like were sometimes made in pieces small enough to permit their transportation on mule-back, and their delivery in remote mining areas, reached only by trail, was accomplished with reasonable ease. More recently, one notes the transportation of four complete gold dredges, power plant, and accessories into the interior of New Guinea by airplane. In building these units a maximum weight per piece was established which was within the load-carrying capacity of the planes. The dredges were assembled at the site just as they would have been at any other place. The hulls of these dredges were constructed according to standard practice. Particularly in view of this fact, the reader will be interested to learn in the following paragraphs of the development and application of a new idea in placer dredge construction—namely, the use of a sectionalized hull made up of unit pontoons bolted together in such numbers as to make a hull of the required size.

Recently, the Yuba Manufacturing Company, of San Francisco, designed and installed on a property near Avon, Mont., an electrically driven, screen-stacker, placer gold dredge of the sectionalized type with a hull of the pontoon construction described. This dredge is built entirely of steel, including the hull, trusses, gantries, and housing, and has a bucket capacity of 5¾ cu.ft. and a digging depth of 26 ft. It has been in operation since Jan. 24, 1934, and is successfully working an interesting area.



A view of the completed hull

The idea of using a sectionalized hull was adopted partly because of the greater ease it would afford in transportation and erection, but more especially to make it possible to dismantle and remove the dredge conveniently after a given area has been worked out. Heretofore, when such re-erection could be proved economical, it was done, the parts suitable for reuse being transported to the new site, where they were re-erected, together with such new parts as might be needed. Under such conditions, the expense for re-erection was equal to the field construction cost of a new dredge, to which had to be added the cost of dismantling, repairs, and replacements. The old dredge, when reassembled at the new site, represented a large part of the cost of an entirely new dredge. For this reason, many placer dredges, upon completion of work in the original area, have been abandoned, after all parts that can be used for replacements on other dredges have been salvaged.

General specifications covering the dredge are as follows: Manganese-steel buckets, 5¾ cu.ft. capacity, of the two-piece type, with removable bushings in the back eye; bucket pins of Yuba special heat-treated alloy-steel forgings; upper tumbler, a one-piece type having body and shaft cast integral and wearing plates of forged alloy steel; lower tumbler, a single-piece manganese-steel casting with a forged alloy-steel shaft pressed in it; digging ladder of structural plates and shapes with heavy steel castings at each end; ladder rollers of alloy-steel castings with cast-steel bearings and cast-iron bushings; main drive of standard Yuba construction and design; main hopper, save-all and grizzly of standard design; revolving screen 6 ft. in diameter by 26½ ft. long, with single roller drive; distributor of standard Yuba design; stacker ladder, 75 ft. long, equipped with a 30-in. stacker belt; gold-saving tables and supports of structural-steel construction with steel-shod wooden riffles; tail sluices of steel plates with renewable liners; ladder hoist and swing winches of standard Yuba design; two spuds of steel and 40 ft. long; dredge pumps, two 8-in. Yuba centrifugals and one 4-in.; and a steam-heating system including a 30-hp. boiler. The electrical equipment consists of motors totaling 297 hp., transformers, and shore cable suitable for 4,000-volt service.

In general design and arrangement the dredge follows the established Yuba standard. The hull, however, is constructed by bolting together 28 steel pontoons, making a hull unit 90 ft. long, 37 wide, and 8 deep. The 24 side pontoons are also 8 ft. deep and 8 wide by 15 long. Three of the four center pontoons are 5 ft. wide, 8 deep, and 15 long, and the fourth center one is 5 ft. wide by 8 deep by 4 long.

Each pontoon is of welded, watertight construction, consisting of structural steel plates and shapes, stiffened by bracing so as to form a rigid unit. The pontoons are further reinforced, when necessary, to take care of special concentrated loads. Each weighs less than 5 tons and has a manhole and two

3-in. pipe plug openings for inserting a portable ejector, or for installing suitable slings for lifting during erection. They are assembled in the pond by floating them into position, each beside its neighbor, and bolting them together with gaskets to prevent leakage. Before this bolting is done, the holes below the water line are fitted temporarily with wood plugs. Less than 1,000 man-hours of local unskilled labor was required to assemble the hull completely.

After the hull is formed, two fore and two aft trusses, spaced 12 ft. apart, are placed as units on the deck. Their lower chords act as longitudinal ties for the pontoons. Gantries and crossbraces, or trusses, are provided for the longitudinal trusses and act also as athwartship ties for the pontoons. They are sectionalized, each unit weighing less than 5 tons. Field connections are made with bolts.

The housing, including the roof, is made entirely of 8x16-ft. steel panel sections, bolted together in the field. All units on dredges of this type, when disassembled, are made up of parts weighing less than 5 tons and of such dimensions that they can be easily handled and transported on a 5-ton truck and trailer.

Erection was done during the winter in remarkably short time, construction being started on Nov. 1, 1933, and the dredge being put in operation on Jan. 24, 1934, as stated in the foregoing. The construction crew, averaging fewer than 25 men, consisted of local unskilled labor, excepting three experienced dredge-construction mechanics.

Construction was directed by the late George J. Carr, who was connected with the Yuba organizations for many years. He was responsible for many suggestions embodied in the design. The dredge is now being operated by Hoyt C. Perring, and is working under conditions more severe than are usually met in the average dredge operations. Its record shows that it is as strong as, if not stronger than, the standard unit. Its cost is within that of a standard dredge, due to the low charge for construction.

The importance of a placer dredge that can be easily erected and as easily dismantled should not be overlooked. It supplies a new viewpoint for considering dredging problems, inasmuch as it makes possible the working of properties usually too small to be considered suitable for dredging. Small river bars, where a dredge cannot be floated from one bar to another, could be worked out by a dredge of this type. Areas of small yardage, ordinarily too small for the standard placer unit, could also be worked. Under such circumstances, the cost of transportation, erection, and dismantling, as well as the "rental" of the dredge, would be charged against the property, instead of its full cost in operating condition.

European Metal-Market Trends

Import Sources Change and Currencies Influence Prices

Richard Merton
Chairman, Metallgesellschaft A.-G.
Frankfurt a. M., Germany

EUROPEAN importations of copper, lead, and zinc from overseas have shown a new trend in the last few years—a trend expressing itself in a relative decrease in the share of imports originating in the United States, Mexico, and South America, whereas a relative increase prevails for the countries which belong to the British Empire and for European colonies.

This trend, readily apparent in the statistics presented in the accompanying tables, would seem to indicate that in reality we are here probably faced with a development which has its cause in the primacy of politics rather than in economics.

Those world-economic connections which have a political basis, such as the relation between a mother country and her colonies, or those binding the various elements of the British Empire, are always better able to withstand a crisis than the purely economic relations between independent states. This probably explains why during the last years the United States and some of the Central and South American countries, which are to a large extent financially dependent upon the former, have experienced a comparatively greater decline in their European exports of copper, lead, and zinc than the overseas territories possessing political connections with Europe. A further point in this connection is that during recent years important new production has been developed in areas which have political and economic connections with Europe. These areas include, mainly, Central Africa and Canada.

In regard to metal prices, attention has repeatedly, of late, been drawn to the importance of the devaluation of the pound and the dollar and other currencies depending on these. By devaluation of these currencies, which are so extremely important in world economics, a considerable basic shift has taken place in the conditions governing production cost in the various competing areas. To this must be added the fact that most countries which have undertaken currency devaluation have, at the same time, been able to maintain the domestic value of their currencies. For these countries, devaluation therefore is not an influential factor in domestic affairs, and the entire increase of the metal prices in the depreciated currency thus becomes an additional gain to the producer.

Owing to the conditions set forth we find considerable divergence of opinion in the various countries regarding "required minimum" metal prices. Although producers in countries with devaluated currencies are already realizing sufficiently high returns from today's metal prices, and do not strive for any increase in these prices in order that the equilibrium between production and consumption may be maintained, present metal prices are entirely unsatisfactory in the countries not possessing devaluated currencies. Maintenance of production in these areas is generally possible only by means of government subsidies, tariffs, and other economic-political measures. This shift in the price conception of the different producers thus acts as an extremely disturbing factor in connection with the private economic measures for regulation of the metal markets by international cartels and syndicates.

Because producers in different countries have diverging opinions concerning the necessary price level, to bring about a unified action in regard to regulation of production is difficult. One has the impression that a healthy condition of the metal markets cannot be reached before the present chaotic currency situation has been overcome and stable monetary conditions again prevail. But even then a long time will be required before the economic shifts resulting from devaluation will again have been balanced. Thus we must first consider a further breaking up of the world economic conditions, on the one hand, and, on the other, a continuous building up of protection for national production in those countries which, without such protection, would find themselves in an inferior position on account of present economic conditions. Economic shifts effected in this manner make national consuming capacity not only a factor of growing importance in domestic economics but also a factor which is gaining more and more significance in the future shaping of the commercial-political relations among the nations. International cartels and syndicates are also affected by these conditions. New conceptions must be formed on the basis of these changed political and economic facts, and we may hope that after the present disturbing conditions have been overcome, a new economic equilibrium among the nations, satisfactory to all, will be created.

Economic Conditions Improve

During the past year the first step was taken toward an improvement in the world's economic conditions; consumption as well as production figures again rose above the low point of 1932. An economic business cycle should thus have been completed, a cycle which started with the recovery from the crisis year of 1921 and reached its crest with the record production and consumption for the year 1929.

Copper—Development of the copper market is well outlined by the general summary presented in the foregoing paragraphs. The decline in consumption and production, which began in 1930 and reached a low in 1932, was, for the first time, relieved by an upward trend in 1933.

Although the average copper price for the past year, calculated on the basis of gold, is still below that for 1932, the decline, measured against last year's conditions, is not of great importance. Based on paper currency, the price shows a significant upward trend. Figuring the year 1928 as 100, the copper price, on a gold basis, averaged about 36 for the year 1933, 38 for 1932, 57 for 1931, and 89 for 1930; for 1933 the copper price, on a gold basis, was consequently only a little more than a third of the 1928 price.

In regard to price developments, the position of the countries on a gold standard must be said to be entirely different from that of countries with depreciated currencies. Although for the latter present prices, calculated on the depreciated currencies, again, to a great extent, present the possibility of profits to the producers, prices figured on a gold basis must still be characterized as entirely unsatisfactory to the European countries with stable currencies.

World Consumption Increases

The increase in the world's copper consumption for the year 1933, compared with that for 1932, is about 190,000 metric tons, or about 21 per cent of the consumption for the preceding year. This increase is distributed as follows: Europe, about 106,000 tons, an increase of about 19 per cent; United States, 60,000 tons, a 22 per cent increase; and Asia (mainly Japan), 20,000 tons, or a 33 per cent increase.

The greatest relative increase in consumption is thus in the Far East. The somewhat greater proportional increase in American consumption, compared with that of Europe, is explained by the fact that the figures for American consumption in 1932 were exceedingly low. In actual consumption figures on a tonnage basis, however, the increase in the European consumption (Russia included) is the greatest for 1933. More than half of the total increase in the world's consumption for 1933, compared with that of the preceding year, took place in the European consumer areas. In spite of this comparatively favorable development of the European copper consumption, which last year reached a total of about 670,000 tons, the figures for 1933 are still considerably lower than those for the record year of 1928, in which year European copper consumption totaled about 823,000 tons.

In regard to the extent to which European copper demand is supplied from local production and from overseas imports, the following facts are of interest: A comparison of the figures for European consumption and production for the years 1928-33 shows a considerable relative increase in the extent to which the European copper requirement is supplied from European production. This development obviously coincides with the general world tendency, according to which the larger consumer areas are more and more adopting the policy of supplying, as far as possible, their own needs for raw materials from their own production. Although, based on 1928 figures, European copper smelters participated in supplying the European copper requirement to the extent of only about 17 per cent, their part in 1933 was about 30 per cent, and in 1932 even about 32 per cent. Correspondingly, the extent to which the European copper requirement was supplied from non-European production (overseas imports) fell from about 83 to 67 per cent. This shift is explained by the fact that, although European copper consumption declined, production of European copper smelters rose during the last six years. Proximity of European copper smelters to consumer areas has thus not only made them considerably better able to weather the crisis but also has permitted them to increase their production during the years of depression. Although, in 1928, European copper smelters produced about 141,000 tons of blister copper, the figure for 1933 rose by about 40 per cent to about 196,000 tons.

The most interesting figure in estimating the European copper market as quite a deciding factor in the world copper market is the additional requirement of non-European production for the various European consumer areas. With a combined European copper consumption of 823,000 tons in 1928 about 83 per cent, or 682,000 tons, was imported from overseas. After reaching a low of about 378,000 tons in 1932, this extra requirement again rose to about 448,000 tons in 1933. In spite of this increase, the additional requirement for 1933 is only about two-thirds of that for 1928.

Based on 1933, the overseas copper import to Europe is distributed among the various countries about as follows: Great Britain, 31 per cent; Germany, 26 per cent; France and Italy, each 12 per cent; Belgium, 8 per cent; Sweden, 5 per cent; Switzerland, 2 per cent, with the remaining 4 per cent divided among a number of smaller European consumer areas.

Overseas Shipments Alter

Still more interesting than the question, By what European consumer areas is this additional requirement taken up? is, perhaps, the question of the origin of these quantities. A comparison of the European overseas copper imports during the last six years shows quite a decided change in the countries from which these shipments originate. Although, for instance, in 1928 the United States participated in the European copper imports to the extent of about 59 per cent, or about 400,000 tons, her part by the year 1933 had fallen to 19 per cent, or about 85,000 tons. Chile, as well, although her relative share in the imports remains at 28 per cent, suffers a loss. The Chilean copper shipments to Europe totaled about 195,000 tons in 1928, against about 124,000 tons in 1933. On the other hand, the Canadian share of European copper imports increased considerably—from about 5,000 tons in 1928 (1 per cent) to about 65,000 tons in 1933 (14 per cent). African (Katanga and Rhodesia) copper shipments to Europe also increased notably; from about 75,000 tons in 1928 (11 per cent) to about 170,000 tons in 1933 (38 per cent).

European Copper Statistics, 1928-33

	1928		1929		1930		1931		1932		1933	
	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent
Production of the European copper smelters	141.2	17.2	164.5	21.1	184.0	25.6	190.2	29.7	184.0	32.6	196.2	29.3
Copper imports to Europe from overseas	682.1	82.8	620.2	79.7	534.1	74.4	492.9	77.0	377.7	66.9	448.3	66.9
	823.3	100.0	784.7	100.8	718.1	100.0	683.1	106.7	561.7	99.5	644.5	96.2
Change in stocks	.....	....	—6.0	0.8	.....	....	—43.0	6.7	+3.0	0.5	+26.0	3.8
European copper consumption	823.3	100.0	778.7	100.0	718.1	100.0	640.1	100.0	564.7	100.0	670.5	100.0
Copper imports to Europe from overseas												
To Great Britain	150.1	22.0	149.6	24.1	139.1	26.0	120.1	24.4	138.2	36.6	140.8	31.4
To Germany	188.9	27.7	144.8	23.3	105.2	19.7	83.8	17.0	86.2	22.8	114.6	25.6
To France	109.8	16.1	125.8	20.3	97.0	18.2	81.4	16.5	42.7	11.3	54.4	12.1
To Italy	73.9	10.9	51.5	8.3	44.0	8.2	46.8	9.5	47.5	12.6	52.1	11.6
To Belgium	72.1	10.6	89.2	14.4	91.7	17.2	87.6	17.8	29.2	7.7	36.2	8.0
To Sweden	16.6	2.4	21.6	3.5	22.0	4.1	19.3	3.9	12.4	3.3	20.0	4.5
To Switzerland(a)	.....	....	.....	....	.....	....	.....	....	5.1	1.3	9.3	2.1
To Netherlands	4.3	0.6	3.0	0.5	3.5	0.7	1.0	0.2	1.8	0.5	2.7	0.6
To Russia(b)	.....	....	.....	....	10.0	1.9	6.8	1.4	1.0	0.3	0.4	0.1
To other European countries	66.4	9.7	34.7	5.6	21.6	4.0	46.1	9.3	13.6	3.6	17.8	4.0
Totals	682.1	100.0	620.2	100.0	534.1	100.0	492.9	100.0	377.7	100.0	448.3	100.0
From the United States	400.0	58.6	343.0	55.3	254.0	47.6	185.0	37.5	105.0	27.8	85.0	19.0
From Chile	195.0	28.6	175.0	28.2	125.0	23.4	136.7	27.7	82.3	21.8	124.0	27.7
From Canada	5.0	0.7	8.0	1.3	1.0	0.2	15.0	3.0	45.4	12.0	65.0	14.5
From Africa (Congo, Rhodesia, Union of South Africa)	75.0	11.0	90.0	14.5	130.0	24.3	140.0	28.5	121.8	32.2	170.0	37.9
From other countries	7.1	1.1	4.2	0.7	24.1	4.5	16.2	3.3	23.2	6.2	4.3	0.9
Totals	682.1	100.0	620.2	100.0	534.1	100.0	492.9	100.0	377.7	100.0	448.3	100.0

(a) For the years 1928–31 under "other European countries." (b) For the years 1928–29 under "other European countries."

European Lead Statistics, 1928-33 *(a)*

	1928		1929		1930		1931		1932		1933	
	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Cent	In per Tons	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cen$_t$
Production from European lead smelters	376.8	44.2	398.7	45.2	412.7	49.1	382.3	48.7	351.6	48.7	335.4	45.1
Lead imports to Europe from overseas	486.4	57.1	507.7	57.5	511.4	60.8	478.8	61.0	401.4	55.6	423.7	57.0
	863.2	101.3	906.4	102.7	924.1	109.9	861.1	109.7	753.0	104.3	759.1	102.1
Lead exports from Europe to overseas	— 4.5	0.5	— 5.5	0.7	— 6.0	0.7	— 3.0	0.4	— 2.0	0.3	— 2.0	0.2
Increase in European lead stocks	— 7.0	0.8	—18.0	2.0	—77.0	9.2	—73.0	9.3	—29.0	4.0	—14.0	1.9
European lead consumption	851.7	100.0	882.9	100.0	841.1	100.0	785.1	100.0	722.0	100.0	743.1	100.0
Lead imports to Europe from overseas												
To Great Britain	240.1	49.4	278.7	54.9	319.5	62.5	284.2	59.4	259.1	64.5	281.0	66.2
To France	57.4	11.8	53.1	10.5	60.6	11.8	55.3	11.5	34.7	8.6	47.4	11.2
To Germany	110.6	22.7	105.1	20.7	70.2	13.7	52.1	10.9	39.8	9.9	39.8	9.4
To Belgium	6.8	1.4	14.9	2.9	20.1	3.9	34.3	7.2	22.0	5.5	13.0	3.1
To Holland	8.2	1.7	9.5	1.9	10.3	2.0	9.5	2.0	7.3	1.8	9.2	2.2
To Switzerland(b)	.....	....	.....	....	.....	....	.....	....	5.5	1.4	3.2	0.8
To Russia(c)	.....	....	.....	....	19.3	3.8	2.2	0.4	8.3	2.1	0.7	0.2
To Italy	0.1	0.0	0.4	0.1	0.8	0.2	6.5	1.4	3.5	0.9	0.2	0.0
To other European countries	63.2	13.0	46.0	9.0	10.6	2.1	34.7	7.2	21.2	5.3	29.2	6.9
Totals	486.4	100.0	507.7	100.0	511.4	100.0	478.8	100.0	401.4	100.0	423.7	100.0
From the United States	78.0	16.0	47.0	9.3	25.0	4.9	1.0	0.2	2.0	0.5	.....	....
From Mexico	101.0	20.8	150.0	29.5	180.0	35.2	190.0	39.7	91.0	22.7	94.0	22.2
From Canada	72.0	14.8	67.0	13.2	60.0	11.7	64.0	13.4	68.0	16.9	80.0	18.9
From Australia	143.0	29.4	151.0	29.7	155.0	30.3	145.0	30.3	177.0	44.1	182.0	42.9
From British India	67.0	13.8	72.0	14.2	70.0	13.7	58.0	12.1	50.0	12.5	55.0	13.0
From French North Africa	25.0	5.1	20.0	3.9	21.0	4.1	20.0	4.2	13.0	3.2	12.0	2.8
From other countries	0.4	0.1	0.7	0.2	0.4	0.1	0.8	0.1	0.4	0.1	0.7	0.2
Totals	486.4	100.0	507.7	100.0	511.4	100.0	478.8	100.0	401.4	100.0	423.7	100.0

(a) Including Asiatic Russia. (b) For the years 1928–31 under "other European countries." (c) For the years 1928–29 under "other European countries."

European Zinc Statistics, 1928-33

	1928		1929		1930		1931		1932		1933	
	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In 1,000's of Metric Tons	In per Cent	In1,000's of Metric Tons	In per Cent
Production of the European zinc smelters	693.3	88.3	704.8	87.8	703.9	94.8	498.6	76.2	400.1	72.6	485.4	80.0
Zinc imports to Europe from overseas	100.3	12.7	105.6	13.2	111.9	15.1	181.0	27.7	122.3	22.2	115.9	19.1
Totals	793 6	101.0	810.4	101.0	815.8	109.9	679.6	103.9	522.4	94.8	601.3	99.1
Zinc exports from Europe to overseas	—7.0	0.9	—8.0	1.0	— 7.0	1.0	— 7.5	1.1	— 6.0	1.1	— 7.0	1.2
Change in the European zinc stocks	—1.1	0.1	.....	.....	—66.3	8.9	—18.3	2.8	+35.0	6.3	+12.4	2.1
European zinc consumption	785.5	100.0	802.4	100.0	742.5	100.0	653.8	100.0	551.4	100.0	606.7	100.0
Zinc imports to Europe from overseas												
To Great Britain	43.9	43.8	54.3	51.4	76.0	67.9	111.3	61.5	69.0	56.4	69.0	59.5
To Germany	28.5	28.4	29.2	27.7	13.5	12.1	29.9	16.5	21.8	17.8	20.5	17.7
To Belgium	1.1	1.1	1.0	0.9	1.0	0.9	18.2	10.0	12.5	10.2	3.6	3.1
To France	3.9	3.9	8.0	7.6	1.8	1.6	6.3	3.5	4.9	4.0	2.5	2.2
To Holland(a)	.....	....	.....	....	.....	....	2.3	1.3	3.3	2.7	1.3	1.1
To Italy	2.8	2.8	1.3	1.2	1.3	1.2	0.9	0.5	0.8	0.7	0.6	0.5
To other European countries	20.1	20.0	11.8	11.2	18.3	16.3	12.1	6.7	10.0	8.2	18.4	15.9
Totals	100.3	100.0	105.6	100.0	111.9	100.0	181.0	100.0	122.3	100.0	115.9	100.0
From the United States	11.4	11.4	11.0	10.4	3.0	2.7	.....	....	1.4	1.1	0.3	0.2
From Mexico	10.0	10.0	16.0	15.2	18.0	16.1	34.0	18.8	25.0	20.4	14.0	12.1
From Canada	51.0	50.8	45.0	42.6	50.0	44.7	90.0	49.7	60.0	49.1	59.0	50.9
From Rhodesia	8.0	8.0	11.0	10.4	17.0	15.2	11.0	6.1	.....	....	17.0	14.7
From Australia	19.7	19.6	21.0	19.9	22.0	19.7	46.0	25.4	35.0	28.6	22.0	19.0
From other countries	0.2	0.2	1.6	11.5	1.9	1.6	.....	.....	0.9	0.8	3.6	3.1
Totals	100.3	100.0	105.6	100.0	111.9	100.0	181.0	100.0	122.3	100.0	115.9	100.0

(a) For the years 1928–30 under "other European countries."

Part of the decline in the European copper imports from the United States may be explained by a decrease in the refining of African copper in that country. But this explains only partly the decrease in European copper imports from the United States. In reality, an important basic shift has taken place in the European overseas copper supply, which, reduced to a short formula, favors the African and Canadian producers at the expense of the producers in South America and the United States. The former are overseas regions, which, during the last years, have developed new productive areas, and which have close economic-political connections with the European consumer areas, either through the British Empire or through Belgian colonial territory in the Congo.

Lead—Also for lead we find the world figures for consumption and production higher for 1933 than in 1932. One may properly here speak of a turn in business conditions in so far as these figures have passed the low point of the depression.

In regard to the development of the price structure for the year 1933, the same reasoning holds true for lead as for copper. Based on gold, the average lead price for 1933 is slightly below that for 1932. For the European countries with no depreciated currencies, this price is still entirely unsatisfactory, although, on the whole, for the countries with depreciated currencies, it again offers perceptible returns. Figuring the average for 1928 as 100, the lead price, based on gold, reached a low of about 38 in 1933, compared with about 41 in 1932.

Regarding the supplying of the European lead requirement from European production and by overseas imports, no important change has taken place during the last few years. In 1933, about 45 per cent of the lead requirement of Europe was taken care of by its own production, whereas during the preceding three years the quantity thus supplied averaged about 49 per cent. The additional European requirement reached a maximum in 1929 with about 511,000 tons, whereas in 1933 about 424,000 tons was shipped to Europe from overseas.

Based on the year 1933, the quantities taken up by the various European consumer areas were about as follows: Great Britain, 66 per cent; France, 11 per cent; Germany, 9 per cent; Belgium, 3 per cent; Holland and Sweden each 2 per cent; Switzerland, 1 per cent; the remaining 6 per cent was distributed among several smaller European consumer areas. In regard to the origin of these quantities, statistics for 1933 indicate that about 43 per cent of the total European lead imports originated in Australia; about 22 per cent in Mexico; about 19 per cent in Canada; about 13 per cent in British India, and about 3 per cent in North Africa (Tunisia). A comparison of the figures for European lead imports during the last years shows an increasing importance of Australian and Canadian shipments, whereas shipments from Mexico show a declining tendency.

Zinc—The general development of the world production and consumption of zinc is similar to that for lead and that for copper. In the instance of zinc the year 1933 also showed a recovery from the low of 1932, and consumption, as well as production, increased materially.

In regard to the price of zinc, contrary to the price of copper and lead, the 1933 figure, based on gold, is above that for 1932. Figuring 1928 as 100, the average 1933 price, based on gold, is 42.4, compared with 38.5 for 1932, which corresponds to an increase in the gold price of not quite 10 per cent. As far as profits are concerned, what was said for copper and lead also holds true for zinc. For zinc also, devaluation of currencies may to a large degree be said to have made possible a profit in the countries where it has been employed, whereas even the slight increase in the price of zinc in 1933 is still entirely unsatisfactory for the European countries with stable currencies.

For zinc, the extent to which the demand of Europe is supplied by its own production is relatively the highest, when compared with lead and copper. Whereas in 1933 Europe supplied only about 30 per cent of her own copper requirements and about 45 per cent of her lead requirements, the corresponding figure for zinc was about 80 per cent; for the years 1928-30 it was even 88 to 95 per cent. Compared with these years, a significant decrease in the share of the zinc requirement of Europe supplied by its own production has thus taken place. Correspondingly, the part supplied by overseas imports increased from 13 to 15 per cent in the years 1928-30 to about 20 per cent in 1933.

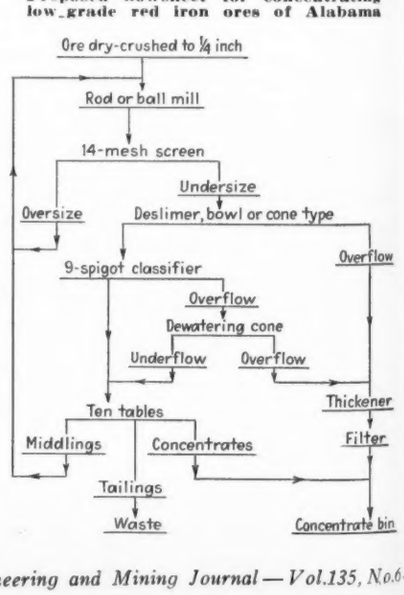
On a tonnage basis, for the last years, European zinc imports from overseas reached a maximum of about 181,000 tons in 1931. In 1933 overseas imports dropped to 116,000 tons, divided among the following countries: Great Britain, about 60 per cent; Germany, 18 per cent; Belgium, 3 per cent; France, 2 per cent; Holland, 1 per cent; the remaining 16 per cent was imported by a number of smaller European consumer areas.

In regard to origin, about 51 per cent of the 116,000 tons imported to Europe from overseas during 1933 came from Canada, 19 per cent from Australia, 15 per cent from Rhodesia, and 12 per cent from Mexico. Against this, European zinc imports for 1928 were distributed among the following countries of origin: Canada, about 51 per cent; Australia, 20 per cent; Rhodesia, 8 per cent; and Mexico and the United States, 21 per cent. Comparing 1928 with 1933, the European zinc imports from countries belonging to the British Empire have increased from 79 to 85 per cent, whereas the corresponding part originating from Mexico and the United States has decreased from 21 to 12 per cent.

Concentrating Alabama's Low-Grade Iron Ores

A FLOWSHEET using only standard methods of gravity concentration is proposed for the low-grade Alabama red iron ores by B. W. Gandrud, A. C. Richardson, and B. S. Followill, of the U. S. Bureau of Mines, in Report of Investigation 3224, just issued. It consists in crushing and grinding to 14 mesh, desliming, classifying, and tabling. The product from each classified spigot and the underflow from the cone dewatering the classifier overflow are tabled separately. Middlings are returned to the grinding circuit. Table concentrates plus the overflow from the deslimer and the dewatering cone are combined as a final concentrate. The method is believed to be more economical than any process heretofore proposed for these ores. The metallurgical results obtainable should compare favorably with those of processes already suggested.

Proposed flowsheet for concentrating low-grade red iron ores of Alabama



●MANY POINTS *of interest center around the work done in recent years in draining, to the estuary of the River Dee, water that seeps in large volume from the River Alyn, through numerous cross-courses, into the lead-ore deposits in the Halkyn district of North Wales.*

●THE MINES *are of historical record; discovery of lead pigs stamped with the effigies of Roman emperors, and remains of primitive smelting plants, testify to the antiquity of operations. Eighteenth-century writers refer to the mines and to the problems of coping with the water underground.*

●A DRAINAGE ADIT, *driven in 1818, led to important ore discoveries, but it was not placed at a sufficiently low level. The tunnel operations to be described constitute a continuation of work begun in 1897, from sea level.*

●DATA PRESENTED *indicate that in several respects a new record has been established for tunnel driving in Europe, a result of the adoption of American methods, American and British equipment, under experienced direction and management, and with the help of zealous and competent labor, on the surface and underground.*—EDITOR.

In the Milwr tunnel, already more than 6 miles long and ultimately to attain 12 miles

Twelve-Mile Bore

To Drain Halkyn Lead District

Advancing at Normal Average Rate of 150 Feet Per Week

J. C. Allan

Halkyn District United Mines, Ltd., Halkyn, North Wales

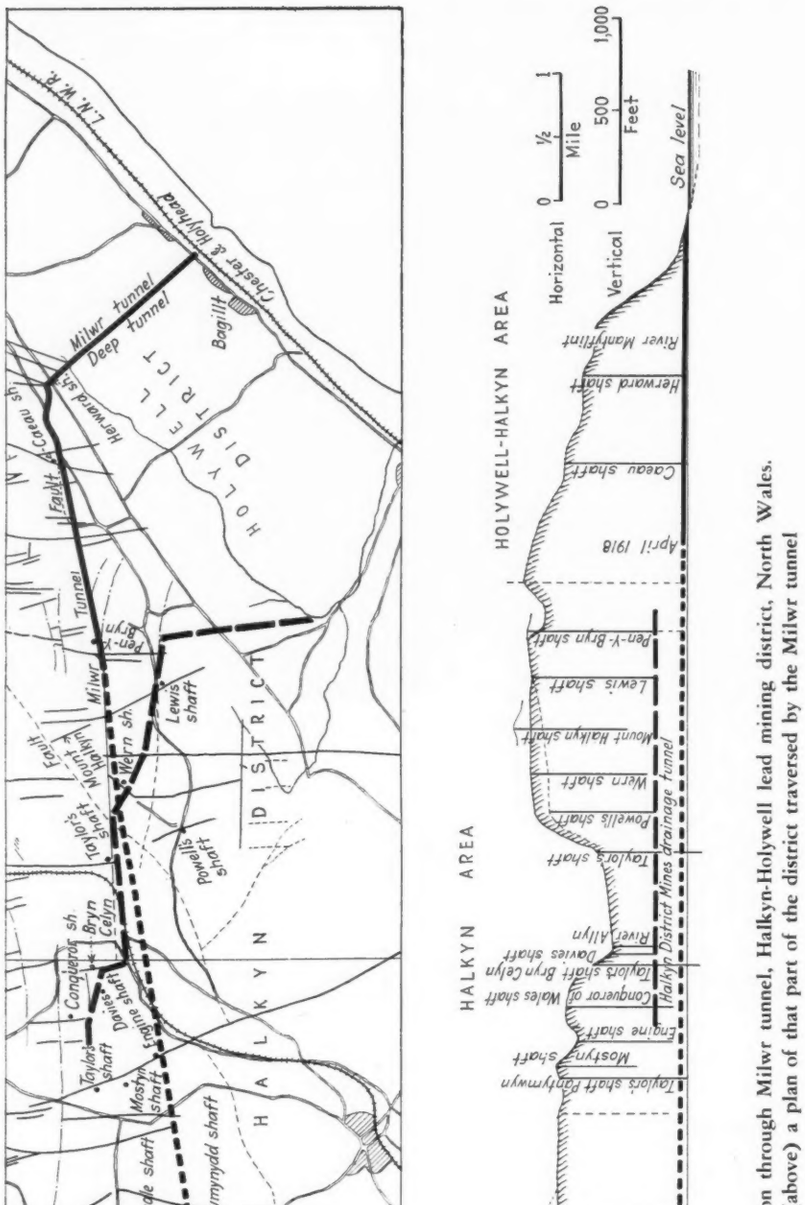
PLANS WERE MADE in 1913 to extend the tunnel, commenced in 1897, that was designed to drain the Halkyn lead mines, in North Wales. The northern boundary of the drainage area was reached in 1919, progress at the rate of 40 to 50 ft. per week being recorded under the stimulus of War demand, in spite of labor restrictions. A pumping method was formulated during the latter period of the War, but it was abandoned soon after the Armistice, when attention was concentrated instead on an amalgamation of all mining interests in the neighborhood, which was finally achieved in 1928, from which date plans were crystallized for an extensive tunnel-driving project, in continuance of the work, suspended in 1919, when the heading was 17,985 ft. from the entry.

The work involved extending the tunnel, which is 10 ft. wide and 8 ft. high, to the Penybryn shaft, involving the sinking of that shaft 200 ft. and the repairing of the Caeau shaft and of the existing tunnel itself. At that time the normal drainage was about 6,000 g.p.m., flowing in a channel or grip provided below and alongside the car tracks in the tunnel. Space was available above this channel for air and water pipes and ventilation ducts.

Drills were selected after competitive tests, the Ingersoll-Rand S 70 being adopted, in conjunction with a 75-lb., X 57, I-R water-feed Jackhamer, used for grip holes, usually five in number and 5 ft. deep. For the usual two vertical drill columns a horizontal bar was substituted, which permitted drilling one-half the holes without repositioning the bar.

For the top series of holes the bar is set about 2 ft. from the roof, necessitating adequate staging and sound supports. Extra rigidity is secured by use of a tightening ratchet of special design. Air for the drills is supplied from two Bellis & Morcom vertical compressors, two-stage, with direct motor drive, set to unload at 100 lb. Drills are reconditioned at a blacksmith shop near Penybryn shaft, equipped with a No. 50 I-R sharpener and auxiliary plant. Only one heading is being driven, inasmuch as the ground ahead of the face is water-logged. The tunnel is in hard, white crystalline limestone.

Eight cut holes are drilled per round 7 ft. 6 in. deep, and about 23 averaging 6 ft. 6 in., making, with the grip holes, 36 in all. Average drilling time is 2 hr. 18 min., with a record time of 1 hr. 30 min. Hollow, round, 1¼-in. drill steel is used for both drills. Blasting is done with 60 per cent Arctic gelignite, 1⅜ in. diameter, in ½-lb. cartridges, and Nobel detonators, fired with an Atlas exploder. Clay, wrapped in newspaper to form 5-in. cartons, is used for tamping, four or five cartridges being placed in each hole. A wall of broken ground, about 20 ft. from the face, is prepared while the holes are being loaded. This tends to reduce fly



Vertical section through Milwr tunnel, Halkyn-Holywell lead mining district, North Wales. Also (above) a plan of that part of the district traversed by the Milwr tunnel

dirt and keep the blast close to the face, facilitating slushing operations.

Ventilation is effected by means of a No. 6 Sturtevant Monogram fan, driven by a 20-hp. motor at 2,800 r.p.m., exhausting 4,000 cu.ft. air per minute through a 20-in. pipe made of 18-gage iron, strengthened by corrugated rings that serve as a shoulder for the joints. This line, suspended by 10-gage fencing wire attached to wooden plugs in roof-hole sockets, is carried to within 100 ft. from the face, from which point leading pipes extend as close to mining operations as is necessary and advisable. The air line is 5 in., Victaulic-coupled, and is exceptionally efficient, and the joints are convenient. A 1½-in. water line is hung from the air line.

A scraper slide, developed and manufactured by the Sullivan Machinery Company and operated in conjunction with a 15-hp. double-drum Turbinair hoist, is used for mucking, the slide delivering to Hudson end-tipping cars on a 22½-in. track. The ground breaks into comparatively small pieces, with a few large ones. Scraping, or slushing, has proved an effective way of securing economical results, speed being governed solely by the rapidity with which the loaded cars can be replaced with empties underneath the scraper platform. A change in the scraper-hoist motor from 6½ to 15 hp. has effectively reduced the time of mucking from the face.

Two 2¼-ton Wingrove & Rogers storage-battery locomotives, equipped with Exide Ironclad batteries, are available to haul from 12 to 15 tons of rock at 6 miles per hour to the Penybryn shaft, up which the cars are raised 800 ft. to surface, by means of a M. B. Wild & Company hoist, at a speed of 700 ft. per minute.

Labor

The three crews each work five 8-hr. shifts and one 6-hr. shift per week, or a total of 138 hr. per week, the normal advance in that time, working two machines, being 150 ft. Only two drills normally are worked simultaneously at the face, the average footage drilled by one machine per round being 117 ft. Broken rock is removed at the rate of about 37 tons per hour, with a total labor force, underground and on the surface, of 71 men, or 17.22 man-hours per foot of tunnel. Power consumption is low—78.80 kw.-hr. per foot of advance.

All employees receive a bonus that varies from 1d. (for a boy on the surface) to 2s. (for the general tunnel foreman) per foot advanced beyond 108 ft. per week. Costs are compiled on a two-weekly basis. Figures for the period from July 1, 1933, to July 15, 1933, inclusive, with data as to results, are as follows: Number of cuts, 74; advance, 495 ft.; explosives consumption per foot, 20.5 lb. The 495 ft. advance was the maximum and was made

Cost per Foot of Tunnel for Period From July 1 to July 15, 1933

	Supervision	Drilling and Mucking	Traffic	Hoisting	Mine General	Surveying	Drill Repairs and Sharpening	General Expenses	Slusher Repairs	Tunnel Support	Ventilation	Total
	4s. 5d.	£ s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	d.	d.	d.	
Labor	.. ..	1 19 2	4 9½	3 3	3 0	1 9	.. 7	1 6	2	3	..	.....
General supplies	.. ..	.. 2 2	.. 1½	.. 2	5 0	.. 3	.. 6	.. ½	..	2	..	.....
Explosives	.. ..	1 4 10	.. 3	.. ..	.. ..	.. ..	.. ..	.. ..	..	..	..	.....
Shops	.. ..	 4	.. 4	.. 1	.. 2	.. ..	.. 6	.. ½	..	..	..	.....
Compressed air	.. ..	.. 5 9	.. ..	.. ..	.. ..	.. ..	.. 10	.. ..	..	..	8	.....
Power	.. ..	.. .. ..	.. ..	.. 9	.. ..	.. ..	.. ..	.. ..	..	..	3	.....
General expenses	.. ..	.. .. ..	.. ..	.. ..	.. ..	.. 1	.. ..	1 0½	..	..	..	.....
Totals	0 4 5	3 12 3	0 5 6	0 4 3	0 8 2	0 2 1	0 2 5	2 8	2	5	11	£5.3.3

working 168 hr. per week, using three machines at the face. This fast work was done during a period when 1,087 ft. was driven with three drills in 31 consecutive days.

Costs per foot of tunnel are given in the accompanying table. The data thus tabulated are for the period July 1 to July 15, 1933.

Average time for the cycle of operations during the period June 3 to July 2, inclusive, when 1,086 ft. were driven, was divided as follows:

Average drilling time (3 face and 5 grip holes), 3 hr. 6 min.
Blowing out holes, charging and blasting, 30 min.
Clearing fumes, cleaning track, taking in and setting up slusher, 39 min.
Loading 64 cars of rock averaging 51 tons, 1 hr. 20 min.

Responsible officials underground, 12-hr. shifts, comprise one general tunnel foreman, one night foreman, acting under instructions of the general tunnel foreman, and two traffic superintendents. In addition, the labor force includes per shift, one ganger, who also acts as drill runner; two other drill runners; two spanner men; one tool nipper; one slusher driver; five shovelers; two grip men; one locomotive driver; and one cage man at shaft bottom. Also, the following are employed on day shift only: one pipe man and mate; one ventilation-line boy; one plate layer and mate; making a total underground force of 53.

Surface force per shift includes: one hoist man; one compressor attendant; two banks men and one wagon greaser. In addition, the following are employed on the day shift only: one electrician and one learner; one blacksmith and one learner; one fitter; one carpenter, part time; one storekeeper and boy; and five laborers on dumps and elsewhere; making a total surface force of 28; and a total underground and surface force of 81. Work is normally suspended from 6 p.m. on Saturday to Sunday midnight. All shifts are 8 hr. long, except from midnight on Friday until knock-off on Saturday afternoon, when 6-hr. shifts are customary.

The success achieved in the work has been possible only by the cooperation and zeal of the British miners and other employees on the payroll, all of whom have demonstrated unusual enthusiasm in an effort to establish a record in tunnel-driving speed and economical performance. The tunnel in October, 1933, was 6 miles from the portal. The intention is to continue it to complete a distance of 12 miles.

Second Collective Bargaining Survey Shows Drop in Adoption Rate

Number of Workers Under Representation Plans Up Since Last November

THE rate of increase in the adoption of collective bargaining arrangements has diminished sharply in recent months, according to preliminary figures from a nation-wide survey announced by the National Industrial Conference Board, which includes information from 2,681 companies which employ 2,093,503 wage earners. This is the second survey of collective bargaining conducted by the Conference Board, the first covering the situation in November, 1933, and the second in May, 1934. The same companies were included in both surveys, so that the results of the two surveys are comparable.

On the basis of information reported in this survey, the proportion of employees still dealing individually with their employers has declined from 48.9 per cent of the total in November, 1933, to 43.8 per cent in May, 1934, a drop of about 5 per cent of the total. Employees under plans of employee representation increased from 43.2 per cent in November to 46.5 per cent in May, and employees dealing through organized labor unions increased from 7.9 per cent of the total to 9.6 per cent. From November to May the number of workers dealing with their employers through labor unions increased 47,519, as compared with an increase of 134,473 in the number in employee representation plans.

Of the employees in companies which in November, 1933, were dealing exclusively on an individual basis, 93.4 per cent were still doing so in May, while 3.6 per cent had changed to employee representation and 3 per cent to labor unions. Of the employees in companies which in November were dealing entirely through employee representation, 97.4 per cent were still doing so in May, 1.9 per cent had changed to labor unions, and 0.7 per cent had returned to individual dealing. Of the employees in companies which in November dealt exclusively through labor unions 98.9 per cent were still doing so in May; 0.6 per cent had returned to individual dealing, and 0.5 per cent had changed to employee representation.

The individual basis of employer-employee dealings still predominates in small establishments. Of the reporting companies with less than 100 employees, 88 per cent were dealing individually, 8 per cent had works committees, and 4 per cent dealt through labor unions. Employee representation is most general in the very large companies, employing more than 5,000 employees, being found in 52 per cent of companies of this size that reported, as compared with 38 per cent dealing individually and 10 per cent through labor unions. Among medium-sized companies, employing from 500 to 2,500 wage earners, 10 per cent dealt through labor unions, 28 per cent had employee representation plans, and 62 per cent were dealing individually.

Ural Asbestos Labor Better Off

WAGES paid mine and mill workers by the Uralasbest State Trust, U.S.S.R., were increased in 1930, at which time the mechanization program was under way, according to Walter A. RuKeyser. The mine wage averaged 2.69 rubles per day, the maximum being at the rate of 5 rubles for skilled miners. The mill average was 1.67 rubles per day, the minimum being 90 kopeks for work on the picking belts and for roustabouts. The high labor turnover and the labor shortage which hit this camp in 1930 are shown by the fact that the number of men on the payroll on June 1 is 15,359 and on Aug. 1, 13,875. Despite this, production constantly increased, due to change in methods and betterment of organization. In addition to actual wages, the workers received indirect compensation in the form of industrial, health, and old-age insurance; free medical attention and hospitalization; six weeks before and after confinement for women on full pay; and one month's vacations to sanataria or other health resorts, with transportation and all other expenses paid, again on full pay; commodity books permitting the purchase of foodstuffs and the like at equivalent of gold prices; and cultural and other social advantages.

Concentrator of Minas de Matahambre, Cuba

Chrome-Molybdenum Cast Iron

At Mine Plant Foundries

R. H. Cromwell

Mining Engineer

AT MINAS DE MATAHAMBRE, Cuba, beginning in October, 1930, the experiment was made of adding molybdenum to the charge of the small cupola iron furnace from which are poured the various castings used at the mine, concentrator, power plant, and docks. The practice has continued.

All castings were poured in sand. The cupola charge consisted of broken-up machinery, scrap manganese steel cut into small pieces by an oxyacetylene torch, old rails, limestone, and coke. It was made up entirely of scrap, no pig iron being added. A typical charge batch to the furnace is given in Table I.

Analyses of the cupola pours or melts changed greatly from pour to pour, for the reason that the scrap available was limited and of variable composition. Before the use of molybdenum a hard, brittle, white iron had been made. At the start calcium molybdate, contained in stout stacks of about 12 lb. each, was added to the charge at the top of the furnace. Ferrochromium was added to the ladle at the time of pouring the castings. Molybdenum in the form of ferromolybdenum may also be added to the ladle, and this method is more flexible and preferable to the use of calcium molybdate in the furnace charge.

Use of chromium and molybdenum was found to increase both the wearing quality and the strength of the castings. The grain of the iron was finer and more uniform, and the castings less porous than before. The first molybdenum castings poured were end liners for the Dewco 6x6-ft. ball mills handling the product from the Marcy mills. These end liners lasted 161 days, as compared to 121 grinding days with cast-iron liners not containing molybdenum.

Some of the castings whose wearing records were watched were the follower plates for the 4- and 6-in. Wilfley sand pumps handling mill tailings and the end and shell liners of the 6x6-ft. Dewco and the No. 64½ Marcy mills. The wearing life of the molybdenum cast-iron follower plates of the sand pumps was 40 per cent greater than those of cast iron without molybdenum. Chrome-molybdenum cast-iron end liners for the Dewco and Marcy mills have proved more economical than either manganese steel or unalloyed cast iron.

Cost of manganese-steel liners delivered at Matahambre was approximately 11c. per pound, as compared to chrome-molybdenum cast-iron liners made locally from scrap material and costing 4¾c. per pound. Addition of molybdenum and chromium increased the cost of our finished castings about ¾c. per pound, as compared to iron without these.

Several sets of cast-iron chrome-molybdenum shell liners for the Dewco regrind mills have been used, and the records to date show they have a longer life than unalloyed cast iron. The comparative life of these liners made from chrome-molybdenum cast iron and manganese steel, grinding Matahambre ore, is shown in Table II. For the shell liners of the Marcy mills handling ¼-in. primary feed, chrome-molybdenum steel shell liners to date have proven more economical than either manganese steel from well-known manufacturers or alloyed cast iron. Experience to date with two sets of the latter has been that they tend to break before wearing out. This is due to more severe service and greater impact in the Marcy mills.

Approximately 170,000 lb. of molybdenum castings have been made at Matahambre, and the results have been satisfactory. Here the replacement of expensive heat-treated steel castings, imported from the United States, by locally made chrome-molybdenum iron, has been found practicable. An example of this has been the track wheels for an overhead crane.

The foundry record and the analyses of the various pours used at Matahambre furnished an experience which has shown that the analysis in Table III gave an excellent material for cast-iron liners of ball mills and like parts. It is not claimed that this anaylsis is the best or the most suitable for all mining plant foundries, as operating requirements and material available will vary greatly.

The ferromolybdenum was secured from the Climax Molybdenum Company, New York, which maintains a research laboratory to assist in developments of the sort described. Recommendations of the technicians of this company as to the use of molybdenum are based on foundry data and service requirements submitted to them, and they will undoubtedly be glad to cooperate with those who may be interested. The ferrochromium used at Matahambre was obtained from Electro Metallurgical Sales Corporation, N. Y.

Table I—Typical Cupola Charge

450 lb.	miscellaneous scrap cast iron
25 lb.	small pieces manganese steel scrap
25 lb.	old rails cut into short pieces
5 lb.	limestone
80 lb.	coke

Table II—Average Life and Cost of Dewco Regrind Shell Liners

Material	Life, Days	Appr. First Cost Cents per lb.	Cost Divided by days
Chrome molybdenum	139	4¾	0.034c.
Manganese steel	194	11	0.057c.

Table III—Analysis for Cast-Iron Ball Mill Liners

	Per Cent
Total carbon	3.00 to 3.20
Manganese	0.50 to 0.70
Silicon	1.00 to 1.25
Molybdenum	0.50
Chromium	0.25

Conditioning in Flotation

Slime Coatings—Activators

Guido R. M. del Giudice

Lecturer in Mineral Dressing,
School of Mines,
Columbia University

IN A FLOTATION OPERATION, in addition to a frothing agent and a collecting agent, other reagents are usually added to bring about one or more of the following desired effects:

1. To control the behavior of fine gangue particles (slime) toward the mineral or minerals to be floated in order to prevent slime coatings. These reagents may be called slime-coating inhibitors.

2. To react with the mineral particles to be floated so that the surfaces of these particles are so modified as to react with the collecting agents to form thereon a water-repellent surface. These reagents are often called activators.

3. To react with one or more of the minerals in the ore in such a way as to prevent their subsequent reaction with the collectors used. These reagents are often called depressors.

Fig. 1—Galena particle from flotation concentrate. X 500

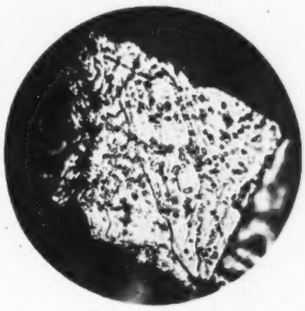


Fig. 2—Galena particle from flotation tailing. X 500

4. To react with and remove, by precipitation or otherwise, salts in solution, which if present would be either injurious to the flotation operation or react with the collecting agent or both. These reagents are often called protective agents.

5. To adjust and maintain the pH of the pulp within such limits that the desirable flotation effects are obtained.

These substances are collectively called conditioning agents, although, as stated in the foregoing, their functions are not related, nor are the ends sought by their addition similar.

The cause of the adverse effects of slimes in flotation was first observed by Taggart[1], Taggart, Taylor and Ince[2], and Ince[3]. They found that when slime particles adhere to sulphide mineral surfaces, the latter show little if any tendency to adhere to gas bubbles.

If an artificial mixture of —65-mesh + 100-mesh galena and —100-mesh calcite is added to water in a flotation cell, and then potassium ethyl xanthate and pine oil are added, and the froth is collected, the tailing, after elutriation, will be found to contain galena particles which are slime coated with calcite particles, whereas the galena in the concentrate will be relatively free from slime coating[4]. See Figs. 1 and 2. If a clean, polished surface of galena is placed in a pulp made up of —200-mesh calcite in distilled water, and the mixture is stirred for a few minutes, the galena surface, after removal, washing, and treatment in a solution of potassium ethyl xanthate, will show no tendency to adhere to a gas bubble. Microscopic examination of the galena surface shows that it is slime coated[5]. See Figs. 3 and 4. Consequently, reagents which control slime coatings thereby control flotation.

Ince[6] made a sketch to show that the reason that slime-coated sulphide particles did not adhere to gas bubbles in the presence of a collector was because the slime particles prevented the gas bubble from coming in contact with the water-repellent film on the surface of the sulphide. A similar sketch is shown in Fig. 5 for a galena surface coated with calcite slime particles and treated in a solution of potassium ethyl xanthate, no implication being made as to relative size and shape. A rough calculation to arrive at the approximate mean relative projections of calcite slime particles and lead ethyl xanthate molecules on the surface of galena has given figures of the order of 1×10^{-3} millimeters and 15×10^{-7} millimeters respectively[7]. This rough approximation indicates that the relative sizes of slime particles and lead ethyl xanthate

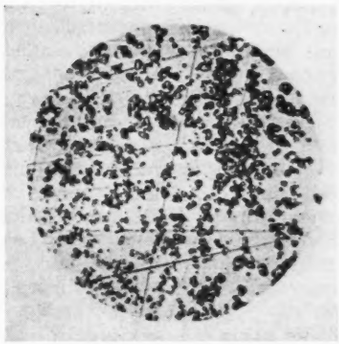
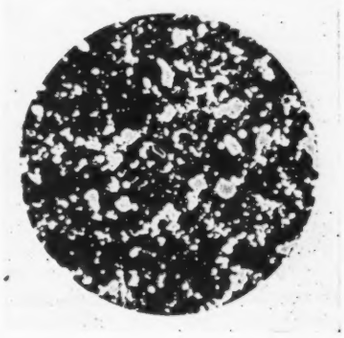


Fig. 3—Galena surface treated in calcite slime. X 500

Fig. 4—Galena surface coated with calcite slime. Ultropaque illumination. X 450



The third of a series by the author. The first and second, which appeared in the two issues preceding, dealt with frothing and collection respectively. The fourth (and last) article will discuss depressors, protective agents, pH control and effect of temperature in conditioning.

molecules as shown in Fig. 5 are distinctly out of proportion; a more correct graphical representation of this figure (not given here for lack of space) would show the projection of slime particles above the sulphide surface about 10 cm., with the distance between adjacent

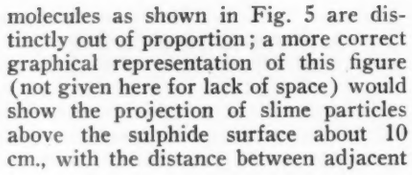


Fig. 5—Galena surface coated with calcite slime particles and treated in a solution of potassium ethyl xanthate. This shows why slime-coated sulphide particles do not adhere to gas bubbles in the presence of a collector

slime particles about 8 cm., with the lead ethyl xanthate molecules as shown in Fig. 5.

Also, another calculation[8] has shown that a galena surface slime coated by agitation for 15 min. in a calcite pulp was covered to the extent of 31 per cent by calcite particles. Clearly, then, the effect of a gangue slime coating on a sulphide is to make the sulphide behave toward a collector as if it were substantially a gangue particle, common gangue surfaces showing no tendency to adhere to a gas bubble when treated with potassium ethyl xanthate[9].

Experiments conducted with galena and calcite[10] seem to indicate that calcite slime particles become attached to a galena surface through a metathetical reaction between the oxidized galena surface and calcite, to give lead carbonate as the cement binding the calcite slime particles to the sulphide surface, lead being the anchored ion on the galena surface. This is shown diagrammatically in Fig. 6. In addition to calcite, it has been found that quartz, sphalerite, rhodochrosite, and even galena slimes coat galena surfaces in water[11].

Water glass (a mixture of sodium silicates) has been found to be an excellent calcite slime-coating inhibitor[12].

Fig. 7 is a photomicrograph of a polished galena surface treated in calcite slime in water to which water glass has been added. Sodium phosphate was also found to be effective as an inhibitor of calcite slime coatings. Abstraction tests[13] seem to indicate that water glass functions as an inhibitor of slime coatings by reacting with the oxidized galena surface to form thereon lead silicates which are less soluble than is lead carbonate (the cement), thereby preventing the reaction between the calcite slime-particle surfaces and the galena surface. At the same time, other experiments[14] have shown that the galena treated with water glass readily abstracts potassium ethyl xanthate from solution, indicating that the relatively insoluble lead silicates on the surfaces of galena are more soluble than lead ethyl xanthate; hence galena treated with water glass would adhere to gas bubbles when treated with potassium ethyl xanthate.

Recapitulating, experiments indicate that the mechanism of slime coatings may be due to a reaction between anchored ions on the mineral surfaces to give a relatively insoluble compound which will then act as the cement between the slime particles and the minerals. The reagents which inhibit slime coatings seem to be those which react with the surfaces of either the mineral which will be floated, or of the slime particles, to form thereon compounds which are less soluble than the cementing compound; though remaining, in the case of the mineral to be floated, more soluble than the compound formed by the interaction between the soluble collecting agent and the salt or salts present at the mineral surface. Inasmuch as the chemical composition of different ores varies, and the slime-coating inhibitors apparently function by chemical reaction, that these reagents must in general vary with the ore seems clear. Water glass, however, appears universally applicable to sulphide ores on account of the relatively low solubility of metal silicates.

Activators

In the discussion under collection I showed that the soluble collectors function by reacting with the surfaces of minerals to give a monomolecular, water-repellent film. I also showed that for the reaction to occur, the surfaces of the minerals had to be more soluble than the salt formed by the reaction between the chemical collector and the surfaces themselves.

Sphalerite (ZnS) when treated with a potassium ethyl xanthate solution does not show any tendency to adhere to a gas bubble[15]. Sphalerite has a solubility in water of about 7 mg. per liter, whereas zinc ethyl xanthate has a solubility of about 330 mg. per liter. Therefore, when sphalerite is treated with potassium ethyl xanthate, no water-

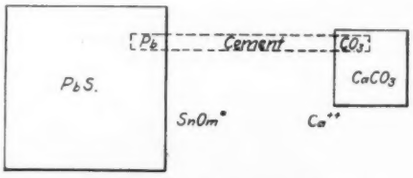


Fig. 6—Diagram illustrating how calcite slime particles become attached to a galena surface through a reaction between oxidized galena and the calcite, forming lead carbonate. See text

repellent film can be formed on its surface. However, if sphalerite is treated with copper sulphate solution and subsequently with potassium ethyl xanthate, the sphalerite will show attachment to gas bubbles. The reason seems to be that the surface of sphalerite is changed to a surface consisting of copper sulphide, which, in the water, oxidizes rapidly and then reacts with potassium ethyl xanthate to give a water-repellent film of cuprous ethyl xanthate. (Copper sulphide minerals, when treated with potassium ethyl xanthate, adhere readily to gas bubbles.) The experimental evidence in support of these statements is as follows:

Powdered sphalerite abstracts copper ion from solution with a corresponding increase of zinc ion. Accord-

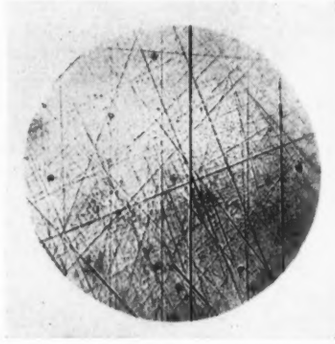


Fig. 7—Polished galena surface treated in calcite slime and water glass. X 500

ing to Fies, Allen, and Merwin[16] the reactions involved are:

$$ZnS + CuSO_4 = CuS + H_2SO_4$$
$$CuS + 7CuSO_4 + 4H_2O = 4Cu_2S + 4H_2SO_4$$

If sphalerite is shaken with $CuSO_4 \cdot 5H_2O$ solution, the color of the sphalerite is visually changed from a yellow to a dark brown. See Fig. 8. The treated sphalerite will abstract xanthate ion from solution with a corresponding appearance of sulphate ion in solution. In this case, then, copper sulphate is the activator for sphalerite.

Wark and Cox[17] have shown that with methyl xanthate, not only sphalerite but also galena, pyrite, and chalcopyrite need activation to obtain bubble attachment. The activators may be soluble inorganic salts of silver, mercury, and copper. With ethyl xanthate, propyl xanthate, butyl xanthate, and amyl xanthate, only sphalerite requires activation. With these collectors lead salts activate as well as silver, mercury, and copper salts. With cetyl xanthate no activation is necessary. See Fig. 9.

The need for activators, therefore, seems to depend on the solubility of the salt formed by the reaction between the collector and the salt at the surface of the mineral. If the solubility of the original salt at the mineral surface is less than that of the salt which would be formed by the reaction between the collector and the surface of the mineral, or, if the solubility of the salt formed by the reaction between the collector and

the surface of the mineral is relatively high, then an activator is necessary. The function of the activator will then be, in the first case, to form a salt at the mineral surface which will have a solubility greater than that of the compound formed when it reacts with the soluble collector; and, in the second case, to form a salt which when reacting with the collector will give a relatively insoluble salt.

Gaudin and Anderson[18] report the use of lead salts to activate malachite, and attribute their function to exchange of the base-metal ions. Gaudin, Glover, Hansen, and Orr[19] report activation of calcite by copper and lead nitrates when soaps are used as collectors.

Anglesite, cerussite, malachite, and other oxidized metal ores, when treated with a collector such as potassium ethyl xanthate, do not show any tendency to adhere to gas bubbles. These minerals, when so treated, react with the xanthate to an extent which is visible to the naked eye. Clearly, then, the extent of reaction is well beyond the monomolecular range. Metal xanthates in bulk show no tendency to adhere to gas bubbles. This is an experimental fact in support of orientation of the water-repellent film in collection[20]. Inasmuch as sulphide minerals, like

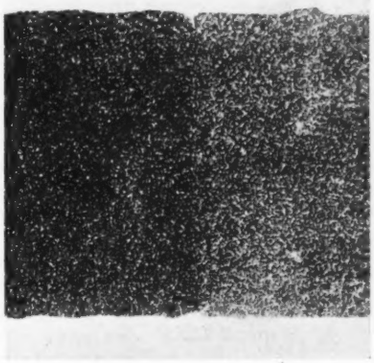


Fig. 8—Sphalerite treated with $CuSO_4 \cdot 5H_2O$ solution is visually changed in color from yellow to dark brown. The dark portion to the left has been treated

galena, give, when treated with xanthates, the desired monomolecular metal xanthate, these oxidized metal ores must obviously be so treated as to approximate the properties of a sulphide mineral surface.

Sodium sulphide (Na_2S) is usually used presumably to form the metal sulphide on the surface of oxidized metal ores. The reaction is indicated by a consideration of the solubilities in water of the oxidized metal ore and of the metal sulphides, metal sulphides being relatively insoluble in water. The surfaces of oxidized metal ores, so treated, then may be considered to be surfaces of sulphide minerals. Sodium trithiocarbonate (Na_2CS_3) seems to give better results than sodium sulphide. This seems due to the difference between the sulphide ion concentrations supplied by the sodium trithiocarbonate and by the sodium sulphide. Apparently, sodium sulphide supplies sulphide ions in such amounts that it is difficult for the "sulphidized" mineral surface to become oxidized in order to react with the collecting agent, as explained in my article on Collection in the May issue. Prolonged, vigorous agitation must be employed to remove the excess sulphide ions. Sodium trithiocarbonate apparently supplies sulphide ions in smaller concentrations, so that the subsequent oxidation of the "sulphidized" oxidized metal ore necessary for reaction with collectors becomes less difficult.

Recapitulating, activators are reagents which react with the surfaces of minerals to be floated, thereby modifying them, so that these surfaces may subsequently react with collectors to form thereon adherent, water-repellent films.

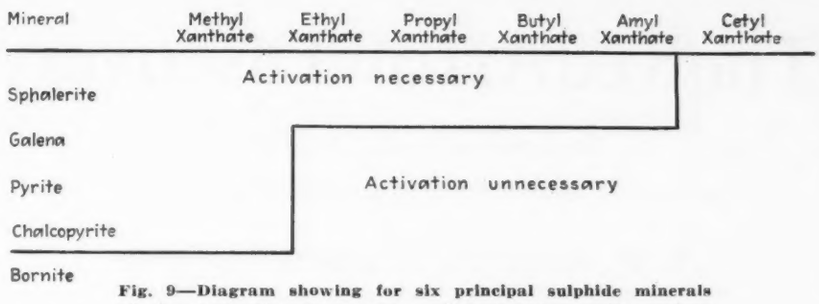


Fig. 9—Diagram showing for six principal sulphide minerals whether activation is necessary after treatment with various xanthates. After Wark and Cox

[1] A. F. Taggart: "Handbook of Ore Dressing," New York, 1927. John Wiley & Sons.
[2] A. F. Taggart, T. C. Taylor and C. R. Ince: "Experiments With Flotation Reagents," *Trans.* A.I.M.E. (1930). "Milling Methods," p. 285.
[3] C. R. Ince: "A Study of Differential Flotation," *Trans.* A.I.M.E., (1930). "Milling Methods," p. 261.
[4] G. R. M. del Giudice: "A Study of Slime Coatings in Flotation," A.I.M.E., T.P. 528 (1934).
[5] See Footnote 4.
[6] See Footnote 3.
[7] See Footnote 4.
[8] See Footnote 4.
[9] I. W. Wark and A. B. Cox: "Principles of Flotation—An Experimental Study of the Effect of Xanthates on Contact Angles at Mineral Surfaces." *Trans.* A.I.M.E., (1932). T.P. 461.
[10] See Footnote 4.
[11] See Footnote 4.
[12] See Footnote 4.
[13] See Footnote 4.
[14] See Footnote 4.
[15] See Footnote 9.
[16] *Economic Geology*, 11, 408 (1915).
[17] See Footnote 9.
[18] T.P. 9, (1930) University of Utah.
[19] T.P. 1, (1928) University of Utah.
[20] See article on collection.

Calrock Asphalt a Cemented Silica Sand

OPERATIONS of Calrock Asphalt Company, of San Francisco, which is mining a bituminous sandstone in Santa Cruz County, Calif., were described by John B. Huttl in *Engineering and Mining Journal* for March, 1934, on pp. 116-117. A description of the characteristics of this sandstone is given in the following paragraphs. It applies only to those grades that are commercially utilized and not to the dry, brittle, and lean grades that are not usable.

The rock consists of an almost pure silica sand, cemented together with a hard, tough, natural bitumen. The percentage of bitumen varies from 9 to 14 per cent by weight, as determined by extraction with benzol. Percentage loss by ignition is only a fraction of 1 per cent higher than the loss by extraction, indicating a low content of calcareous or insoluble organic matter. Sand recovered after extracting the bitumen is clean and sharp and light gray in color. A typical sieve analysis is as follows:

	Per Cent
Minus 200 mesh	4.0
Minus 80 mesh plus 200 mesh.	27.9
Minus 40 mesh plus 80 mesh.	43.6
Minus 10 mesh plus 40 mesh.	24.5
	100.0

Attempts have been made to determine the penetration of the contained bitumen by dissolving it out of the sandstone and evaporating the solvent. These tests yield penetrations of 8 to 20 at 77 deg. F. However, it is believed that this process changes the character of the bitumen by lowering its penetration, and that the actual penetration in the sandstone is somewhat higher than the tests indicate.

The specific gravity of the bituminous sandstone rock as quarried varies from 1.92 to 1.97.

The rock is fairly hard at normal temperatures, but no hardness tests have been made. It splits easily with gads and wedges, particularly on the colder days. On very hot days, splitting is more difficult, due to the yielding of the material.

As quarried, the natural rock resembles, but is slightly harder than, a hard sheet asphalt pavement designed for heavy traffic. It is tough at all normal temperatures, and for this reason is difficult to shatter effectively with explosives. It varies in color from jet black to grayish black, sometimes slightly mottled.

The Red Arrow Discovery

An Unusual Gold Occurrence in Southwestern Colorado

A. P. Root, Jr., *Chemist*
Jesse Simmons, *Mining Geologist*
Durango, Colorado

DISCOVERY of a vein yielding nuggets and lumps of gold, unquestionably the most spectacular of recent years, was made in the summer of 1933 at the Red Arrow mine, in a little-known part of the La Plata Mountains of southwestern Colorado. Much publicity has been given to it in the press and motion pictures. In many respects it deserved all of this attention, and facts enough concerning it are available to make interesting reading. This discovery has served to bring directly to the attention of mining men a region that has produced high-grade ores for seventy years and which, because of this find, has received a noticeable stimulus that is likely to result in much valuable development in the district this year.

The Red Arrow was found in June, 1933, by Charles Starr and his son, Raymond, while they were tracing the source of high-grade placer pannings up Gold Run draw. This gulch is a tributary of the East Mancos River. The discovery is near the southeast corner of Sec. 11, T. 12 N., R. 36 W., on the southwesterly flanks of the La Platas.

The vein, 2½ to 5 ft. wide and averaging 3½ ft., is a typical fault fissure, filled with sandstone fragments, calcite, barite, limonite, quartz, and talc. It strikes east-west and dips south 65 to 70 deg. It is in rocks of Jurassic age, locally named the La Plata formation. Present development is at an horizon probably 50 to 75 ft. above the 15-ft. limestone which occurs slightly above the center of the 300-odd ft. of massive sandstones and sandy shales that are designated as La Plata by Whitman Cross in United States Geological Survey Folio No. 60.

In the course of exploratory operations, the vein has been followed by a 140-ft. tunnel, giving a depth of 50 ft. below the surface. To date no stoping has been done; all efforts have been concentrated upon driving the tunnel and saving the valuable material broken in the course of excavating it. Ore is in sight in the roof and floor of the tunnel for its entire length.

In the draw below the discovery the fissure passes into the Permian rocks. West of and in the direction in which the tunnel is being driven the vein has been identified on the surface for about 900 ft. Approximately 14,000 ft. in the same direction a vein of similar character has been found which may be the Red Arrow vein; if so, its course has been altered slightly either by a bend or fault, both common in the district.

As noted, the vein cuts the La Plata sandstone at a sharp angle. Near the Red Arrow the regional dip of the La Plata formation is 10 to 12 deg. southwest. A mile to the north it steepens abruptly to 35 deg. The vein walls display evidences of vertical movement that has left breccia and slickenside planes. Though no definite markers have been observed, the displacement is thought to be about 25 ft., with the footwall elevated that distance with respect to the hanging wall. That displacement has taken place is amply proved by the fact that the footwall is comprised of sandstone and shale layers in about equal quantities, whereas the opposite wall includes considerably more shale.

High-Grade Production

In the course of driving the tunnel the leaner material is blasted away, leaving the high-grade streak, which later is carefully taken down, sorted, and screened. The exceptionally rich portion of the vein amounts to anywhere from 8 to 20 in. of the entire width. It has no regularity of occurrences; it may be on either wall or anywhere between. In it the gold is found in particles, nuggets, and lumps. The remainder of the vein averages about 3 oz. of gold to the ton.

Total production to the end of March was approximately $20,000—certainly a splendid return for driving 140 ft. of tunnel. The first commercial output of 1933 consisted of three lots: (1) Screenings to the amount of 7,122 lb., which yielded $3,891.01, gross, at the smelter; (2) crude gold and "nuggets" sorted from the screenings, which brought $1,550 at the mint; and (3) a narrow-gage carload of ore, 17 tons, which yielded $1,557.83 gross at the Golden Cycle mill, at Colorado Springs. During January, February, and March, 1934, as drifting was continued, handpicked and screened high-grade was saved to the amount of 28.29 lb., which by melting yielded 210.96 troy ounces of bullion, 813 parts fine in gold and 165 fine in silver, worth $6,005; also, two carloads were sent to the mill, one with a gross value of $1,406.21 and a second worth $4,800. Regular shipments of ore and bullion are now being sent out.

The ore faces are still as encouraging and as spectacular as at any time since the discovery. The mine gives every indication of continuous future yield if it follows the precedent established by a dozen or more similar veins in this district that have been systematically exploited.

From the foregoing résumé the reader will note that the ore contains an almost unbelievable amount of native gold. It occurs in irregular-shaped slabs ranging in size from small particles to pieces weighing 8 and 10 oz. and more. This gold appears in two classes: a brilliant, lustrous, foliated, or leaf gold, but more frequently as dull-colored "mustard" gold, in more or less compact masses coated with dark-brown limonite. The character of the gold indicates that it is an oxidation product of some form of telluride, a theory strengthened late in March by the identification, in the course of analysis, of partially oxidized calaverite.

A highly efficient method of handling this gold after it has been recovered by screening, hand sorting, and panning is to melt it in graphite crucibles with a flux of sodium bicarbonate and borax to slag off the gangue. The metal resulting from this direct treatment is the bullion mentioned, which is marketed at the Denver mint.

The Red Arrow Gold Corporation, owner of the mine, is a closed corporation, composed of the discoverers and associates. It is capitalized for 300,000 shares of no par value stock. The directors are Charles H. Starr, president; Howard Starr, George W. Gilmore, Jr., Raymond Starr, James M. Brown, and George W. Gilmore. The offices are at Mancos, Colo. No stock is for sale.

Future plans include the installation of grinding and amalgamating equipment which it is believed will simplify recovery of the free gold. Tailings from this plant will be shipped, together with lower-grade crude ore, to a custom mill.

The La Platas—An Immense Dome

The La Platas are a domical uplift that may be designated as the most southwesterly extension of the San Juan Mountains. They involve, in the portion containing metalliferous veins, rocks from the Permo-Carboniferous Cutler beds, upward successively through strata up to and including the Cretaceous. Their highest point is Hesperus Peak, 13,225 ft. The other principal summits lie within a 9-mile circle. These rugged peaks rise abruptly from a country of plains and mesas surrounding them from east and

south to west, and they stand boldly above the saddles connecting the range with the Rico and San Juan Mountains to the north and northeast. Both stream and glacial erosion has cut sharply and deeply into these mountains.

Intruded into the sedimentaries forming the mountains are various porphyries and lavas in the form of sills, stocks, sheets, dikes, and laccoliths. The flexing of the sedimentaries opened many vertical fissures from a foot or so to several feet wide, that in many instances have been traced through the various sedimentary strata. These fissures are often filled with vein material containing native gold and high-content gold minerals, such as tellurides and gray copper, and in other cases the commercially valuable metal is silver. A very large proportion of the yield in past years has come from telluride ores.

Subsequent to the enrichment of the veins, and probably in Tertiary time, periods of profound faulting occurred, both vertical and lateral, that had little if any effect on the mineralization of the veins, but put the operator and the geologist on their mettle. In the Idaho-May Day group, the most completely developed vein system in the district, a set of three parallel veins are involved in a series of lateral faults that displace them 1,300 ft. in an east-west direction, at right angles to their strike. These have been productive for nearly half a mile along their strike, and are pointed to by La Plata operators as evidence of the persistence of the veins and their productivity for considerable distances.

Records are available of twenty or more mines that have yielded pay ore in the amount of $50,000 or more each, with the high yield from individual properties running from $2,500,000 to $3,000,000. These figures are the more impressive when one considers the fact that mills are rare in the La Platas; and that the majority of the ore went, and still goes, to the wagon road by burro train, though the slow-moving ox team has given way to the more modern tractor and truck for transport from the foot of the trail to the railroad.

The Red Arrow discovery, together with a recent disclosure of high-grade calaverite in the Lucky Moon mine, at Parrott Peak, 2 miles east of the Red Arrow, has brought into prominence a considerable area of the southwest part of the La Platas that in the past has been only casually prospected. In this sector, in coming months, all exposures of the La Plata formation will be most critically examined, for Idaho-May Day, Red Arrow, and Lucky Discovery are at least three major demonstrations of the productivity of veins of that horizon.

On account of the rugged topography of the La Platas, where steep slopes alternate with talus-covered hills, narrow ravines, and deep canyons, many of the mines are accessible only by trail.

Ohio's Mining Engineering School As a Service Department

State University Has Found New Plan Successful

Edward V. O'Rourke

Associate Professor
Department of Mine Engineering
Ohio State University

OPPORTUNITY exists for the mining engineering department of any large university to act as a service department to the university at large. Many teachers of mining engineering have been concerned only in enrolling the students for the entire curriculum. Thus, they have failed to point out the elective possibilities of courses in mining.

Prior to 1926, at Ohio State University, almost the sole outside service rendered by the mining department was to the departments of metallurgy and ceramics in one required course. In the autumn of that year, Mr. Nold, chairman of the mining department, and I began to ascertain by interview the interests of majors in other departments in work pertinent to mine engineering. We found that civil engineers were interested in explosives and rock work. Ceramic engineers demanded an opportunity to study something of proper plans for clay mine operations. Students in geology wished to take courses dealing with exploration, production, and transmission of petroleum and natural gas. Students in non-ferrous metallurgy had an interest in prospecting and methods of mining. There were other scattered interests. No new courses for these additional men were necessary, the engineering students having had the essential prerequisites. Students in geology were either seniors or graduates and were required to have a year of college physics.

Recently we have been endeavoring to interest commerce students whose major field is the public utility. They would be helped greatly in studying the problems of gas reserves, production, transmission, and distribution of natural gas. This would require a new course.

In the enrollment of our regular major students we find an increase, in spite of a considerable decrease in the engineering college, since 1931. This shows that the "outside electives" have not affected the department adversely.

The accompanying table proves the success of our plan. It includes only electives, omitting the registration students in metallurgy and ceramics who are required to take one mine engineering course.

Enrollment of Students Electing Courses Given by The Mine Engineering Department, Ohio State University

Year	Quarter			Totals
	Autumn	Winter	Spring	
1924	3 Metallurgical Engineering			3
1925				
1926	1 Geology	1 Geoolgy		2
1927	4 Ceramic Engineering	2 Geology		7
1928	1 Geology 3 Geology	3 Ceramic Engineering 1 Civil Engineering 1 Geology	2 Ceramic Engineering 1 Geology	11
1929	1 Industrial Engineering 1 Geology	1 Metallurgical Engineering 1 Geology	3 Geology	7
1930	7 Ceramic Engineering 1 Mechanical Engineering	4 Civil Engineering 3 Geology 4 Metallurgical Engineering 1 Industrial Engineering	1 Civil Engineering 1 Geology 1 Industrial Engineering	23
1931	7 Ceramic Engineering	7 Civil Engineering 2 Mechanical Engineering 2 Metallurgical Engineering 2 Geology	1 Chemical Engineering 2 Chemical Engineering	23
1932	1 Electrical Engineering 1 Ceramic Engineering 1 Metallugical Engineering 2 Geology	11 Civil Engineering 1 Architecture 4 Metallurgical Engineering	1 Civil Engineering 1 Metallurgical Engineering	23
1933	1 Chemical Engineering 1 Metallurgical Engineering	6 Metallurgical Engineering 2 Geology 2 Mechanical Engineering 1 Chemical Engineering 1 Ceramic Engineering 5 Civil Engineering	2 Chemical Engineering 1 Metallurgical Engineering 8 Ceramic Engineering	30
1934		1 Metallurgical Engineering 9 Civil Engineering	4 Ceramic Engineering	14

SILICOSIS

Its Economic Aspects

Benjamin F. Tillson

Consulting Engineer,
Montclair, N. J.

DEMAND FOR INFORMATION pertinent to the economic aspects of silicosis is too great to ignore; and so I interrupt the continuity of my series of articles on silicosis to discuss the subject.

A member of the legislative committee of a miners' union seriously seeks aid for promotion of the health of his fellow workers. His letters indicate the rising interest of the laborer in an intelligent consideration of his working conditions. Whether all of his points of view are true expressions of facts is beside the issue; they must be accepted by industry for correction of conditions or of misunderstandings by labor. The following quotations are offered:

"The mine officials here have long been aware of the dangers of dust, but have never made more than a half-hearted effort to abate the hazard. The more intelligent miners have always wet down their places and advised their fellows to do the same, but there never has been a systematic campaign to educate the miners about the dust hazard. This is one of the things our union hopes to bring about in connection with our effort to get silicosis legislation." . . . "We have already realized that it will be difficult for us to obtain far-reaching social legislation with the present political set-up of this state." . . . "The last Legislature was largely controlled by the mining and utility companies, and so we are laying the groundwork of a movement by which we hope to unite the workers and farmers behind a common program beneficial to both classes." . . . "There are several hundred old-time miners who are in various stages of silicosis, but who are still able to do a day's work and make a living. It is possible, if they are covered by the law and the law should pass, that they would immediately be X-rayed and cut off the payroll. Then we have the same situation referred to in your second article—miners who have worked in every mining company in the West. We could not expect the local companies to compensate these men for a disease contracted under other employers.

"Of course it has already become apparent to me that silicosis legislation is a problem too difficult and complex for ordinary miners to cope with by themselves, but we are convinced that a start must be made some time. If nothing else, we will drag the subject of dust disease out into the open and give it the publicity that it deserves. I believe that there has been a studied effort here in —— to minimize the importance of silicosis. If a miner dies from tuberculosis complicated with silicosis the disease is never mentioned in the press. They call it a 'long illness.'

"We visited the —— tuberculosis sanitarium about two weeks ago and got some interesting figures. For the five-year period, 1929-33, there were 179 men admitted from —— county, and, of these, 151 miners, 80 per cent of the population of the county, are concentrated in this mining camp. The adult male population is about 20,000, but during the period mentioned the actual underground workers did not exceed 4,000. During 1932-33 27 men from this county died at the sanitarium from tuberculosis and 23 of these were local miners. Nearly every miner's case was combined with silicosis."

Cost of Compensation

Lengthy comment upon the considerations that silicosis and tuberculosis are progressive diseases that take long periods of time for fatal developments, and that the number of underground workers before the depression in business was probably greatly in excess of the number quoted in the foregoing, is quite unnecessary. Sufficient to note that the problem raised is real and not imaginary, and that a considerable sum of money might well be involved in compensating sufferers on the rising basis of claims and settlements prevailing elsewhere. Suits are being brought for $100,000 per individual affected, and W. H. Heinrich, of the Travelers' Insurance Company, in his recent book, "Scientific Accident Prevention," concludes that the total cost of an accident to the manufacturer is four times the compensation cost because of the "hidden costs," many of which also apply to occupational diseases. Such "hidden costs" involve: absenteeism, labor turnover, and lowered efficiencies of labor and plant operations.

Direct costs may be classified in three divisions in accordance with methods involved in compensating the injured:

1. Voluntary assumption by the employer of medical and hospital expenses, and pensioning or otherwise reimbursing the sufferers for loss in earning capacity from vocational hazards. This requires initiative in discerning the hazard by the employer and a progressive attitude toward meeting his social obligations before public opinion or political bodies force him to do so. It proves the best economy to him because of lower settlement costs, the greater good will of his employees and the public at large, and the more earnest attitude which he assumes in reducing the hazard to a minimum. No figures of the cost of silicosis under such a condition are available.

2. With state control of industrial diseases under compensation laws the costs of compensation will vary greatly with the wording of the laws. In some legislation the right to bring actions at common law is left as an alternative in accident compensation, and in other acts such a right is superseded and voided by enrollment of an employee under the protection of the compensation law. Also, the law may set a limit to the legal and medical fees paid, or may grant the court discretionary powers in such awards. Again, the laws may, or may not, be worded and enforced to do justice impartially to employer and employee. Number and nature of dependents greatly influence the amount paid, and a quick death often reduces compensation cost below that for lingering illness with total disability.

Payments on the Rand

In the Union of South Africa various forms of silicosis legislation have been in effect since 1911, and various one-sum and monthly installment awards are made to a silicotic miner or his dependents in accordance with many factors, including the stage of silicosis and the presence of tuberculosis, both of which have usually been limited to about $3,750 per case. Also, monthly allowance awards are made, based upon half a month's earnings where the latter does not exceed $100, an additional quarter of the next $41.50 month's earnings, plus one-twentieth of any excess. A dependent wife or two dependent children each increase the foregoing total by one-fifth, a third dependent child by another one-tenth, and additional children by one-twentieth. About $97 is the maximum monthly allowance granted to a single (unmarried) miner; and about $140 a month is the maximum granted to a married miner with children. According to the Report of the Miners' Phthisis Board, March 31, 1932, an aggregate amount of about $65,000,000 has been paid since May, 1911, in benefits for silicosis to 15,839 original awards, which thus averaged about $4,130 each; and the outstanding liability exceeded $34,000,000. On March 31, 1932, the mines had as pensioners receiving such monthly allowances

1,533 miners (of whom over 400 had received $10,000 each and 138 had received over $15,000 each); and 3,074 dependents of deceased miners were in receipt of monthly allowances (of whom over 600 received $10,000 each, and 62 over $15,000 each). In addition, there were 606 miners and 1,090 dependents of deceased miners whose payments had ceased. One-sum awards reaching $6,000 have been made. The maximum paid any miner or dependent was less than $18,500. The total number of original awards from 1911 to 1932 is 15,839. During 1932, silicosis compensation on the Rand was about $6,000,000.

In Ontario, with silicosis legislation, the affected miners were formerly removed from the hazard and given an award for their incapacitation. The laws have been in a state of change, but the Workmen's Compensation Board report showed costs as follows up to Jan. 1, 1934:

Compensation and medical aid paid	$880,743
Handling claims	68,552
Expenses of examinations	209.020
Supervision	11,435
Reference board	19,689
Total	$1,189,439

Losses in the United States

In the United States no states have as yet enacted silicosis compensation laws, but six of them (Missouri, California, Connecticut, Massachusetts, North Dakota, and Wisconsin) have occupational disease legislation, worded broadly to permit its coverage. However, specific coverage of silicosis is now sought in at least New Jersey, New York, Wisconsin, and Massachusetts. The experiences of the last are well stated in a recent legislative report, No. 1,350. Prior to 1927, few claims had been made in Massachusetts for disability from dust inhalation. Losses so incurred averaged about $69,000 for the years 1926, 1927, and 1928, and ranged from $57,833 in 1928 to $123,344 in 1930, averaging about $117,000 for 1929, 1930, and 1931. Because of a Supreme Court decision, January, 1929, that a silicosis case was entitled to compensation under the act, losses incurred under insurance policies issued in 1929 were more than twice those under 1928 policies, although payrolls in 1929 were only 30 per cent higher. Insurance rates per $100 of payroll in the granite industry were advanced on Dec. 5, 1927, from $2.84 to $4.50 and a year later to $4.77, and even at this last rate many insurance companies refused the risk. On April 1, 1929, one insurance company formed a special stone-industry group at a rate of $10, but soon had to raise it to $12, and finally abandoned writing such insurance in November, 1931, to avert financial disaster from resultant losses. This has been followed by a $5 rate for all stone-cutting risks (with a $500 minimum premium), plus an additional occupational disease hazard payment of $300 per year for each employee where conditions warrant (or probably over $1 per day worked by each employee). A foundry received a ten-day advance notice of insurance cancellation and could not place its insurance in another company without X-raying its 160 workers and without assuming the risk of silicosis claims from 42 of them (with a possible loss of $200,000 or more).

In Wisconsin, the total compensation cost of silicosis cases to the employer or insurance carrier increased from $31,467 in 1929 to $50,442 in 1930, and to $96,590 in 1931; and dust cases have been receiving awards recently of $5,000 to $20,000 each. Former death awards of $6,000 under compensation laws have risen to $18,000 under common-law awards, and on Sept. 10, 1931, the Wisconsin Commission had $600,000 of silicosis claims outstanding. The insurance rate for stone-cutting there is $8.04, compared with the present $3.54 rate in New York.

In New Jersey and New York silicosis legislation is being considered. It has been estimated that if the latter should include silicosis as an occupational disease without any qualification, any industry in which that dust hazard exists would have its payroll costs increased 5 to 10 per cent to insure against such liability, and in normal times over $8,000,000 increased expense might thus be involved annually. However, New York Senate Bill No. 1,905, on silicosis, has just been printed in place of the blanket coverage mentioned in the foregoing. It sets a limit of $25 per week for 260 weeks (total $6,500) as a maximum for total disability for silicosis and a minimum of $8 per week (unless the workers' earnings are less, and then apply) for the same period. Death benefits are the same as those prescribed in the accident compensation laws; and occupational disability (partial) shall not exceed $1,000. (Since writing the above, I am advised that this bill has been killed.)

A Serious Threat

3. Where suits in common law are preliminary to compensation settlements, the economic threat is extreme, for awards have reached as high a figure as $28,000 per individual, and in the same locality 43 more suits are pending. Several years ago the damage claims ran from $5,000 to $10,000, but now $100,000 is not an uncommon claim for an individual. For example, in one plant of about 100 employees 100 suits were brought, each for $100,000, or a total of $10,000,000. Eighteen claims in another state totaled $1,600,000; and 30 plaintiffs in another sued for $3,000,000, settled out of court for $134,000, but leave twenty more suits pending. In one section of the country a dusty trade which employed 2,000 men had, in five years, 92 occupational disease claims (including 68 for death or permanent total disability) and suffered losses of $3,000,000. Another industry has against one insurance company 28 alleged silicosis claims of from $10,000 to $50,000 each and totaling $982,500; and between 350 to 400 suits originated on a 3-mile tunnel, the claims to date possibly reaching $12,000,000, although the project probably did not cost more than $15,000,000 to construct. In one state the silicosis hazard in one branch of the stone industry requires about 20 to 25 per cent of the payroll to meet the losses on account of dust claims, which virtually amount to life insurance payments. Analysis of approximately $300,000 in losses in one insurance company doing general workmen's compensation and liability business, for recent industrial-disease claims, showed 54 per cent for cases involving pneumonoconiosis (silicosis, asbestosis, and related diseases), 26 per cent for lead poisoning, 9 per cent for various dermatitis cases, 5 per cent for benzol poisoning, and the remaining 6 per cent scattered. A reputable source is authority for the statement that from 1,000 to 1,500 such suits have probably originated in New York State, with claims aggregating $50,000,000. All figures cited indicate that at least $300,000,000 in silicosis claims have originated in the last few years.

Cost in Silica Grinding

Analysis of insurance data for the silica-grinding industry in a certain state shows that during the six years 1926 to 1931 there were 56 compensable cases (not including silicosis losses, for they would be common-law awards) totaling about $21,000, against a payroll of about $1,440,000; therefore an average rate of $1.459 per $100 of payroll. But in the five years from 1927 to 1931, with a payroll of about $1,166,000, there were an additional 112 cases of silicosis suits at a total cost of about $151,400 and a rate of $12.995 per $100 of payroll. So, in that industry, the common-law cost of silicosis was about 8¾ times the statutory (silicosis excluding) compensation costs.

In the hand-molded glazed-pottery industry for the same six years there were 509 statutory compensation cases, costing $126,566, against a payroll of $26,454,700, or $0.478 per $100 of payroll; and in the last three years common-law suits for silicosis added a burden of $36,370, total cost for twelve cases, which, based upon a payroll of $8,888,600, added $0.409 per $100 of payroll. But the rate for silicosis in 1931 of $1.366 per $100 of payroll may indicate a coming situation like that in the silica-grinding industry. The increased cost per case of the common-law settlements of occupational disease claims reported by insurance companies in that same state may also be significant. In 1930 there were 35 cases, costing $53,262, and 29 cases in 1931 cost $61,138, and of the latter 20 were for silicosis, at a cost of $55,443. No records are available concerning additional settlements made by companies practicing self-insurance.

The involved nature of the insurance situation has possibly been partly responsible for the many failures to enact specific silicosis laws in the United States. Of the five state where an employee may present a silicosis claim to a compensation board, only two—California and North Dakota—have state insurance funds in operation. Therefore the insurance against silicosis losses, whether from suits at common law or from compensation-board awards, is almost entirely a private enterprise in this country. Insurance companies are of three classes, mutual (cooperative), fraternal, and stock companies. In the first two any unusually favorable experience is reflected in the dividends returned to each policyholder, and in the last such dividends go to the stockholders in the capital structure of the company. It is evident that the insurer must receive total premiums sufficient to cover the losses sustained by the total policies issued, and also pay the overhead expenses for sales, management, investigations, services to insured, taxes, and possible losses in investments from unpredictable circumstances; to establish surplus funds to meet catastrophes and amortize depreciating property; and, in the case of stock companies, to make a reasonable return on the invested capital which is an asset subject to the needs of the insured. State departments of banking and insurance, and compensation rating bureaus, supervise the soundness of the management, and the fairness and uniformity of the terms of the policies and their respective premium rates. One of the vital factors is the determination of the risk. With the ordinary physical hazards covered by accident insurance, where the injury is sudden and complete, its occasion definite, and its nature usually immediately detectible, the frequency of occurrence and the severity of results become matters of record; and when sufficient experience is gathered the laws of probability may be applied to large, well-diversified exposures with reasonable assurance that the losses will not fluctuate too widely and rapidly to be met from a moderate reserve fund.

Rate Determination Difficult

With occupational diseases, and especially with so insidious, slowly developed, and progressive a disease as silicosis, the determination of non-prohibitive insurance rates becomes a great gamble until extensive experience data have been collected and analyzed, until the public has reached conclusions as to the fair valuation of the types of injuries, and until social legislation becomes crystallized and uniform. The peculiar idiosyncrasies of individuals in respect to their susceptibilities to various diseases add confusion to the issue but will be taken care of by the law of averages when rates can be based upon sufficient experience under a modern social structure. The rates should also provide a merit and penalty schedule to promote increased protective measures, save life and health, and reduce economic waste. However, for the protection of the workers, compensation insurance should be made compulsory on the employer and also on the insurance companies under terms approved by state supervision. The terms of the compensation laws should be specific, so as to avoid any abuse of them in the nature of the social principles of unemployment, old age, or health insurance, and a uniformity in the acts of the various states would be highly desirable.

Rights Under Standard Policy

Considerable diversity of opinion still exists as to the rights of the insured under the Standard Policy which has been generally in effect since the passage of workmen's compensation laws until recently. Even officials in the insurance companies are quoted as being at odds as to whether its terms were intended to cover all possible liability of the employer for the occupational hazards of his workmen. The man most responsible for drafting that policy form is reported as saying that its intent was for such coverage; and it is claimed that the insurance company must defend the employer against any such action at law which is brought against him by an employee, including common-law occupational disease claims, such as for silicosis. The issue is, however, confused by the precedent set by two court decisions (in the states of New Jersey and Illinois), which relieved the insurance carriers from liability for silicosis claims in suits at common law. Those who deny the apparent weight of such decisions claim that the bankruptcy of the insured prevented them from presenting an adequate legal defense.

The first paragraph of the Standard Policy describes it as applying "as respects personal injuries sustained by employees," and the second half of the second paragraph indemnifies the employer against loss "by reason of liability imposed upon him by law for damages on account of injuries referred to in the insuring clause" (the first paragraph). We may note that so far no reference is made to accidents; but paragraph 7 becomes the bone of contention, as it says, "This agreement shall apply only to such injuries so sustained by reason of accidents occurring during the Policy Period limited and defined as such in item 2 of said Declarations." The argument is based upon whether the intent of this paragraph was merely to define the period of coverage, because of the words capitalized, and whether the word "accidents" was loosely used to mean the occurrence of injuries, or whether its intent was to limit and change the nature of the coverage which the insured had been led to believe he was buying. To some the latter interpretation would indicate a "tricky" contract to which the legal phrase *"Caveat emptor"* would apply. The frequency with which insurers (carriers) are said to have used the word "accidents" to express the sense "occupational diseases" in making official rate filings in various states may weaken their position.

The whole rate-making situation is further complicated by the fact that silicosis claims are frequently made years after the policy expires, but that does not relieve the carrier of liability.

However, if the courts in other states should decide, as they did in New Jersey and Illinois, that liability would be passed on to the insured employer who, in a false sense of security, had supposed that no further costs than the insurance premiums he had paid could enter into the products which he had already marketed, the burden placed on the latter might become unsupportable. Some insurance officials are said to agree that their past premium rates carried a surcharge for occupational disease risks, and others deny it. But state rate-making bodies have seen that the same standard rates were used by carriers now expressing the two diverse viewpoints, so some occupational disease coverage is indicated. Also, when the carriers have gained official state sanction for additional loadings on the premiums to meet such specific hazards, they are said to have continued their use of the Standard Policy without any added endorsement to extend it to cover occupational disease claims.

Another puzzling situation results from the contention that the statute of limitations does not start its term until the employee has knowledge that he is suffering from an occupational disease. The courts have so ruled in some states, and claims have been initiated even twenty years after the employee's exposure.

Legal Technicalities

Recently, new types of policies have been issued with one or the other of two endorsements either excluding occupational disease coverage, or else including some such coverage in return for an additional premium. The insured should carefully study the latter endorsement to determine whether it meets his needs, for it has been claimed that it does not protect against most of the common-law occupational disease suits which might be brought against him.

The magnitude of the economic threat of silicosis and the suddenness with which it has descended upon employers and insurance carriers are evidently beyond their conception or preparation, even though the terms of the policies and the premium loadings were intended to cover occupational diseases. We must decide whether it is really so serious that, to avoid bankruptcy and dislocation of industry, social legislation must be restrained from giving complete protection to individual workers in the interest of society as a whole.

Automatic Control
In a California Cement Plant

Plays an Important Part in Conveying, Grinding, Processing

J. B. Huttl

Assistant Editor

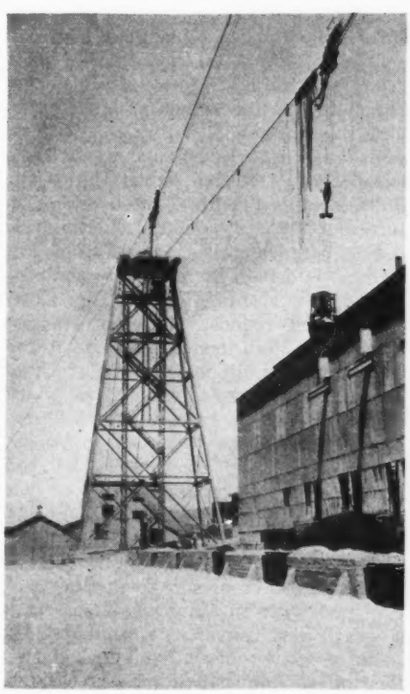
FEW cement companies have gone to greater length in adapting electricity and automatic control equipment than has the Santa Cruz Portland Cement Company at its operations at Davenport, Calif. The large processing plant, with a capacity of 14,000 bbl. a day, built on a sloping site not a great distance from the ocean, and the abundant evidence of able, efficient management, offer much to excite the interest of the visitor. To select the most important of numerous unusual features is difficult, but perhaps the extent to which foresight has been exercised throughout the enterprise may be justly singled out as being particularly impressive.

The plant is almost entirely automatic in operation. This has been accomplished by ensuring constant and uniform feed to the various units, and by using equipment of ample capacity. For instance, sequence control is employed throughout the plant. This control is so arranged that the motors will start one after another, in any order or sequence desired. In addition to the advantage gained by starting the motors in the correct order, automatic control is so interlocked that, if any motor is shut down owing to failure of its electric circuits or to failure of its mechanical load to function properly, all preceding motors will automatically shut down. Of more than ordinary interest are the simple, yet effective, home-made control devices to be described later, which play an important part in the kiln, drying, and grinding departments.

Diversification in application of cement in recent years called for refinements in processing, and for the development of an adequate and efficient flowsheet for intermediate and superfine grinding. Accordingly, modernization of the raw-grinding and finish-grinding plants was undertaken in 1925. Five 10-ft. Hardinge conical mills operating in closed circuit with corresponding air classifiers were substituted for the small ball mills and tube mills used. Three of these units were installed in the raw-grinding plant and two in the finish-grinding plant. The dust problem common in dry-process plants has been overcome satisfactorily by the installation of a modern dust-collecting system.

Material-handling costs are low, as full advantage is taken of the sloping plant site. Plant operations progress downward from the coarse-crushing plant to the packing house near the seashore. The quarry is about three miles distant in the westerly spurs of the Coast Range. Limestone is mined by glory-hole methods, as described in *Engineering and Mining Journal,* June 15, 1929, Vol. 127, pp. 954-956. From the quarry the mined rock is hauled in trains of twenty 15-ton steel cars by two 18-ton Baldwin-Westinghouse trolley locomotives over a narrow-gage railroad, about 3½ miles long, to the crushing station of the plant. On the unloading floor of the building each car is first spotted by a drag cable to a rotary car dumper operated by a 25-hp. motor connected to a Pacific Gear & Tool Company speed reducer, and then dumped gradually through an open hopper into the primary crusher.

Clinker handling cableway at the plant of the Santa Cruz Portland Cement Company



Primary crushing is done in two stages. The rock is crushed in an Allis-Chalmers No. 18 gyratory crusher driven by a 150-hp. motor, the crushed product flowing by gravity via a series of distributing chutes to four bar grizzlies with 2½-in. openings. The grizzly oversize goes to four Allis-Chalmers Gates No. 6 gyratory crushers, driven in pairs by two 150-hp. motors, to be reduced to 2½ in. Doors provided on the aforesaid chutes make it possible to cut out any of the gyratories when the plant is running at decreased capacity or when a gyratory must be shut down for any other reason. Grizzly undersize and the secondary crusher product pass over a 36-in. incline-belt conveyor to the rock-storage building, to be screened and segregated according to the lime and clay content. The materials can be stored in the building proper or stockpiled outside.

From the storage building the sized rock is reclaimed by a series of conveyors, installed in tunnels under the floor of the building, which discharge to a 24-in. tunnel conveyor, equipped with a magnet suspended at the discharge end to remove tramp iron, leading to the drying plant. Stockpiled material is reclaimed and discharged into feeders above the tunnel conveyors by a Bucyrus diesel shovel mounted on a caterpillar track. Obviously, primary blending of materials is an easy matter in view of the flexibility of the conveying system.

At the crushing plant the problem of "gummed" chutes and crusher equipment when treating clayey rock has been solved in an ingenious way. Prior to crushing, the rock is sprinkled with fine dust obtained from the dust-recovery plant. Each rock particle is thus covered with a thin, dry layer of dust, which reduces considerably the stickiness of the material and facilitates travel through the crushers and chutes.

At the drying plant a short incline conveyor discharges the rock into a feed hopper, whence it is fed by small belt conveyors to two oil-fired 7x72-ft. rotary dryers. An automatically controlled dividing gate on the feed hopper serves to deflect the rock stream and proportion the feed to the dryers. Drying operations, with the exception of the oil burners, are entirely automatic. This

is accomplished by the simple control system consisting of homemade automatic control devices shown in Fig. 1. In the event of overloading one or the other dryer, the power requirement of the dryer motor drops and causes solenoid *A* or *B* to close the lever switch *A* or *B*. This in turn actuates

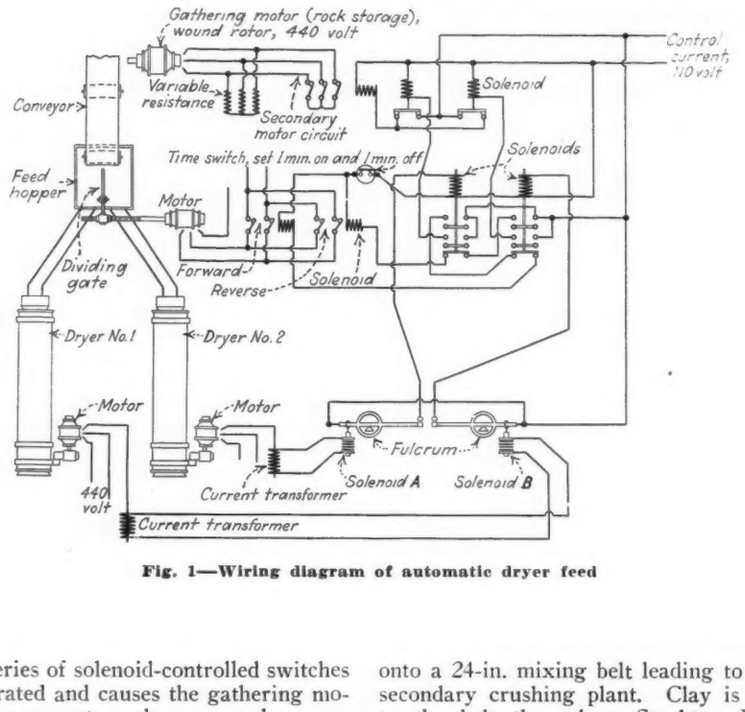


Fig. 1—Wiring diagram of automatic dryer feed

the series of solenoid-controlled switches illustrated and causes the gathering motor to run at a slower speed, consequently reducing the feed to the dryers. The forward and reverse movement of the motor operating the dividing gate is controlled by a time switch set 1 min. on and 1 min. off, and two solenoid-operated switches contained in the circuit.

The dryer product is raised by two bucket elevators and dumped upon two pivot bucket conveyors installed above five concrete storage bins, with a capacity of 375 tons each. Three of these bins are reserved for stone with a high lime content, and the other two are used for storing rock of lower grade. A sixth bin with a capacity of 335 tons is available for storing clay needed occasionally for producing a perfect mix. Clay required for blending is obtained from the company's quarry at Glenwood, Calif., about 18 miles east of Davenport. The clay receives no other treatment than drying. This is accomplished in a rotary dryer adjacent to the finishing building, the dried clay being belt-conveyed to a loading bin. Here it is loaded into cars and hoisted over an incline and dumped into a hopper above the raw-grinding mill building. From this hopper the clay is fed by a 4-in. conveyor to the 335-ton storage bin.

Little use is made of the dryer and conveying equipment, as the clay content of the stone received from the quarry is fairly uniform. Grade of the contents of each storage bin is known, and they are drawn off in measured proportions so as to give a blend of the desired lime limit. To facilitate this operation, each rock bin is equipped with a Stephens-Adamson pan feeder that discharges onto a 24-in. mixing belt leading to the secondary crushing plant. Clay is fed to the belt through a Stockton Iron Works reciprocating gate.

The product delivered by the mixing belt is discharged into a 7-ft. Symons cone crusher driven by a 250-hp. synchronous motor, set to produce $\frac{3}{8}$-in. material. Secondary crushing is also done in two stages. The crusher product falls upon a 30-in. conveyor that delivers it to a 125-ton concrete surge bin alongside the roughing bins. From here the material is fed by roll feeders, with quadrant cut-off gates, to two parallel rows of five 4x6-ft. Hum-mer units equipped with 7-mesh Ton-Cap screens.

Each feeder unit, consisting of five feeders, is driven by a 5-hp. motor connected to a Pacific Gear & Tool Company speed reducer. Screen oversize goes via a 30-in. conveyor to a 150-ton concrete surge bin containing three hoppered compartments, whence it is fed through quadrant gates to three 40x36-in. Allis-Chalmers rolls, set to $\frac{7}{8}$ in., driven by 50-hp. motors. The roll product returns over the 30-in. conveyor operating between the cone crusher and the surge bin to the Hum-mer screens. Minus 7-mesh material or the screen undersize passes over a 24-in. conveyor equipped with an automatic sampler to a short screw conveyor, and thence to a 24-in. conveyor operating above a battery of 40 hopper-bottomed steel bins, arranged in two groups consisting of a single row of 28 and 12 bins respectively. Samples taken at the head of the 24-in. conveyor are analyzed at the chemical control laboratory near by, and the results tabulated on a board. This gives the operator an accurate knowledge and control of the contents of each bin.

The desired blend to be sent to the raw-grinding plant is obtained by drawing at suitable feed rates from one or more of the aforesaid group of bins. Two 24-in. reclaiming conveyors under the bins convey the drawn materials to a surge bin at the end of each row of bins. From these bins the rock passes to two Schaffer poidometers, adjusted to feed an equal amount of stone from each bin to a bucket elevator feeding a mixing screw conveyor. This conveyor discharges its load upon a 24-in. conveyor, which, in turn, feeds to a 30-in. conveyor, equipped with three stationary trippers, installed above the mill feed storage system consisting of four 1,000-ton concrete bins.

In the raw-grinding department three 10-ft. Hardinge conical mills, each driven by a 400-hp. motor, are available. The material from three of the four mill storage bins is fed to the mills by 18-in. belt conveyors. Mills Nos. 1 and 2 operate in closed circuit with standard 12-ft. Hardinge air separators and one 14-ft. and one 16-ft. Sturtevant air separator. Oversize from the Hardinge separators, discharged through a special chute, goes over a 24-in. conveyor and a bucket elevator to the Sturtevant air separators, the oversize from these separators being returned to the mills by a system of 24-in. conveyors. Mill No. 3, because of its larger grinding capacity, operates in closed circuit with a

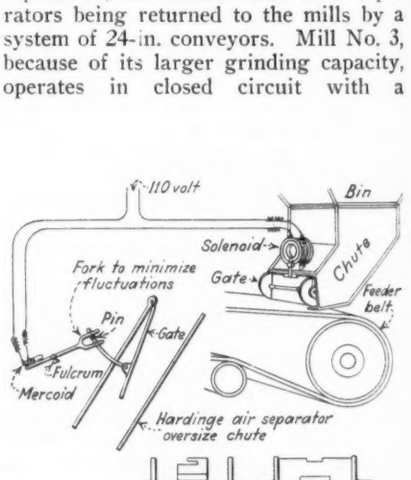


Fig. 2—Automatic mill feed on two Hardinge raw mills

Hardinge air separator only. The fines, averaging 90 per cent minus 200 mesh, are conveyed by an inclosed screw conveyor system to eight 320-ton concrete blending silos in the kiln department. Final blending of the finely ground raw material takes place here. Each mill also employs a No. 100 Clarage fan.

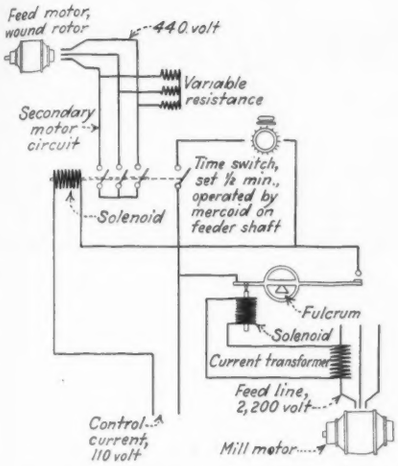


Fig. 3—Wiring diagram of automatic mill feed

Feed to the mills is controlled in a unique manner. At mills Nos. 1 and 2 this is accomplished by the simple arrangement shown in Fig. 2. The mechanism consists of a depression gate installed in the oversize chute of the air separator; a mercury switch connected by a lever attachment to the depression gate; a solenoid; and a revolving gate fitted with diametrical blades of varying cross-sectional areas.

The scheme of operation is simple. As the feed to the mill increases or decreases, the depression gate is raised or lowered by the material flowing through the chute, thus making or breaking electrical current in the solenoid, which, in turn, releases or locks the corresponding blade on the revolving gate in the spout of the feeder chute. The feed to mill No. 3 is controlled as shown in Fig. 3. It is similar to the scheme employed at the drying plant shown in Fig. 1, with the exception that the time switch, consisting of a small mercoid operated by a lever attachment and two disks with protruding prongs on the feeder shaft, is set ½ min. Here, too, overloading of the mill or a drop in power requirement of the mill motor immediately reduces the speed of the feeder motor.

The kiln equipment consists of eighteen 7x125-ft. oil-fired kilns. Heat control is effected by a ring of pyrometer leads at the kiln stack. A Hoskins pyrometer records the temperature. Normal temperature required for calcining the limestone is about 2,700 deg. F.

From the blending silos the raw material is fed to the kilns by screw conveyors operated by sprockets and chains mounted on a shaft, driven by a large sprocket and chain on the kiln proper, as shown in Fig. 4. The screw conveyor at the base of the kiln stack removing precipitated flue dust is driven in a like manner. This arrangement insures a constant and uniform feed to the kiln, as any change in kiln speed automatically reduces the speed and quantity of the feed to the kiln. Bucket elevators installed between each pair of kilns raise and discharge the hot clinker through steel chutes to the stockpile outside the kiln building. From here the clinker is removed to the main clinker storage yard by two Blaw-Knox clamshell buckets, suspended from two overhead cableways. The span between the two steel towers is about 950 ft. The clinker storage yard is adjacent to the finishing building and has a capacity of 500,000 bbl.

Fuel oil for the kilns, and for the stone, clay, and clinker dryers, is obtained by gravity from a 6,500-bbl. steel tank near the plant. The kiln building also contains an automatically controlled oil heating plant. Total oil storage capacity at the plant is 157,000 bbl.

From the main storage yard the clinker is reclaimed by fourteen belt conveyors operating in tunnels under the storage yard. These discharge the clinker onto the gathering conveyors leading to the crushing department of the finishing plant. The layout of this department is similar to that of the secondary crushing plant in the raw-grinding building. Clinker is crushed in one 54x24-in. Allis-Chalmers primary roll, and one 40x36-in. secondary roll of Allis-Chalmers manufacture, operating in closed circuit with four Hummer screens. During the rainy season the clinker is bypassed to an oil-fired rotary dryer before going to the rolls.

Finished grinding is done in two 10-ft. Hardinge conical mills equipped with 12-ft. Hardinge air separators. Gypsum for blending is obtained from mines in Nevada. The equipment for treating the raw gypsum, consisting of a Raymond impact pulverizer kiln mill connected to a small oil-fired air heater, conveying machinery, feed and storage bins, is housed in the finish-grinding building. Proportioning of the crushed clinker and calcined gypsum is done by Schaffer poidometers.

As in the raw-grinding department, the mill feed and gypsum feed is controlled automatically by the simple installation shown in Fig. 3. The 95 per cent minus 200-mesh finished cement from the Hardinge separators is pumped to the main storage and packing plant by two 8-in. Fuller-Kinyon pumps. The oil-well cement produced at the plant is pumped to a 5,000-bbl. storage house by a 6-in. Fuller-Kinyon pump. In the finish-grinding plant six of the original ball and tube mills still in place are used for grinding this type of cement exclusively.

Twenty bins from 3,000 bbl. to 12,000 bbl. in capacity provide a finished storage capacity of 110,000 bbl. Loading of these bins is controlled by a Fuller-Kinyon control board installed in the finish-grinding building. At the packing plant the cement is sacked by seven 3-spout Bates packers. Bulk cement can be loaded into railroad cars by special equipment available at the packing plant.

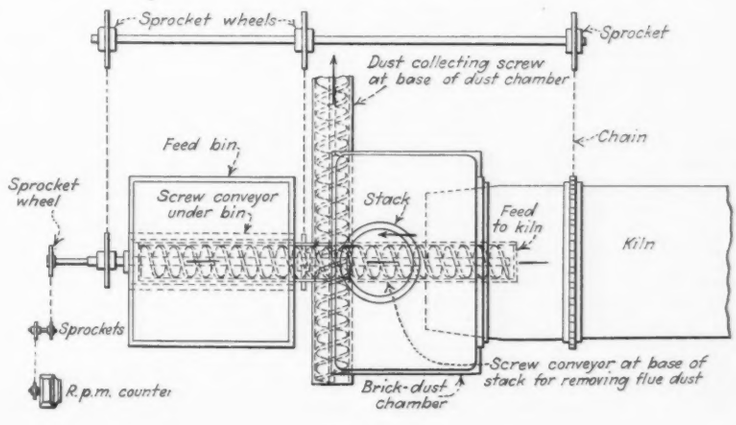
The dust-collecting system consists of a number of Sly dust collectors installed at strategic points. Collected dust is conveyed by enclosed screw conveyors to separate storage bins, to be used for various purposes. Enclosed conveying machinery is used wherever possible. The material-handling equipment is of Stephens-Adamson manufacture. General Electric and Westinghouse motors and accessory electrical equipment, and Pacific Gear & Tool Company speed reducers are used throughout the plant.

Two laboratories are maintained at the plant; one for physical tests and the other for chemical analysis. Systematic sampling provides close control on the chemical status of the finished products. A constant humidity and temperature room is available for the storage of test pieces.

The company markets five brands of cement: Standard portland cement; regular plastic cement; waterproof plastic cement; special oil-well cement; and high-silica cement.

The operating personnel includes Joseph Riordan, plant superintendent; Frank C. Languth, plant engineer; L. R. Davis, quarry superintendent; and E. W. Rice, chief chemist. Robert A. Kinzie, San Francisco, is consulting engineer.

Fig. 4—Arrangement for feeding raw material to the kilns



NRA Approves Lead Code

Effective Date: June 4

APPROVAL of a code of fair competition for the lead industry was announced May 25 by Hugh S. Johnson, National Recovery Administrator. The code establishes a 40-hour work week of five 8-hour days. Minimum wages are fixed as follows: For unskilled labor in the mining division, 40c. an hour above ground and 47½c. an hour underground; for employees engaged in processing, 35c. an hour in the lead smelting and refining division, 40c. an hour in the lead pigments division, and 35c. an hour in the metallic lead products and metallic lead foil products division. In the smelting and refining division a 5c. differential is given the South, making the Southern rate 30c. an hour. The code became effective June 4.

Membership of the Code Authority comprises the members of the executive committee of the Lead Industries Association, the secretary of the association, and five division chairmen, representing the lead mining division, lead smelting and refining division, lead pigments division, metallic lead products division, and the metallic foil products division. In addition the code provides for one to three other members, without vote, to be appointed by the Administrator.

The text of the code, which in its original form was submitted Aug. 3, 1933, by the Lead Industries Association, follows:

ARTICLE I

Purposes

To effectuate the policies of Title I of the National Industrial Recovery Act, this Code is established as a Code of Fair Competition for the Lead Industry and its provisions shall be the standards of fair competition for such Industry and are binding upon every member thereof.

ARTICLE II

Definitions

Wherever used in this Code, or any supplement appertaining thereto, the terms enumerated in this Article shall have the meanings herein defined unless the context shall otherwise clearly indicate.

Section 1. The terms "President," "Act," and "Administrator" mean respectively the President of the United States, Title I of the National Industrial Recovery Act, approved by the President June 16, 1933, and any amendments thereto, and the Administrator for Industrial Recovery.

Section 2. The term "Member of Industry" includes all those engaged in the Industry either as an employer or on his own or its own behalf.

Section 3. The term "Employee" means and includes anyone engaged in the Industry in any capacity receiving compensation for his services, irrespective of the nature or method of payment of such compensation, except a member of the Industry.

Section 4. The term "Employer" means and includes anyone by whom any such employee is compensated or employed.

Section 5. The term "Apprentice" as used herein means an individual (usually a minor), bound by indenture, executed in compliance with the laws of the state where the service provided for therein is to be performed, to serve an employer for a term of years at a predetermined wage, for the period of the indenture, in order to learn a trade, art, or craft.

Section 6. The term "Industry" as used herein includes the mining of lead ore and/or the concentrating thereof, the smelting of lead ore, and/or lead concentrates, and/or lead-bearing scrap, the refining of lead and/or lead-bearing scrap, and/or drosses, the manufacturing of pig lead, antimonial pig lead, lead pigments, metallic antimony, metallic lead products, allied products defined hereinafter as "metallic lead products" and/or "metallic foil products," and the original sale of such products by the member of Industry producing or manufacturing the same either directly or indirectly through subsidiary and/or affiliated companies.

(a) "Lead Ore and Lead Concentrates" as used herein is defined to mean ore and the concentrates thereof, containing lead as the principal commercially recoverable constituent.

(b) "Lead Mining" as used herein is defined to mean the mining and concentrating of lead ore and any further beneficiation thereto prior to the shipment to the smelter.

(c) "Lead Smelting and Refining" as used herein is defined to mean metallurgical and/or chemical treatment of lead ore, lead concentrates, lead-bearing scrap, and/or drosses and/or any other lead-bearing material into "Pig Lead," and/or "Antimonial Pig Lead."

(d) "Antimonial Pig Lead," inasmuch as antimony is a common constituent of most lead Ores and a byproduct of Lead Mining, Smelting, and Refining, Metallic Antimony and Antimonial Alloy Products (Antimonial Pig Lead) shall be included within the provisions of this Code.

(e) "Lead Pigments" as used herein is defined to mean basic carbonate white lead (dry or in oil), basic lead sulphate (dry or in oil), litharge, red lead (dry or in oil), orange mineral, or any other lead oxides, with or without metallic lead content.

(f) "Metallic Lead Products" as used herein is defined to mean extruded, rolled, cast or otherwise fabricated lead or lead alloy products (except storage-battery plates and lead-covered cable) produced by Members of Industry and kindred products of metallic tin and tin alloy, or other metal or metal alloy products, which are produced by the same Members of Industry on the same type of machinery and under similar labor and fabricating conditions.

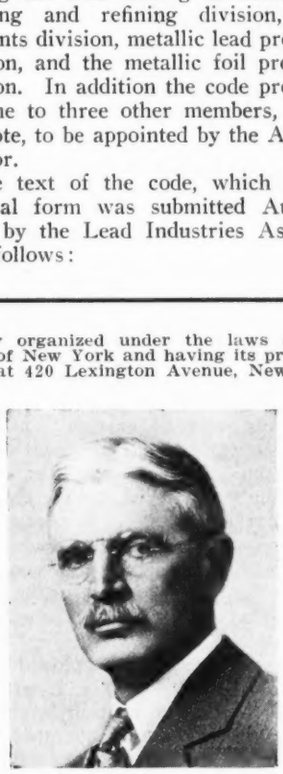
(g) "Metallic Foil Products" as used herein is defined to mean lead and/or tin and/or zinc or their alloys or combinations thereof rolled to a thickness of 0.006 of an inch or less, whether attached or affixed to other materials or not.

Section 7. The term "division" as used herein includes the several parts of the Industry as enumerated below:

1. Lead mining division
2. Lead smelting and refining division
3. Lead pigments division
4. Metallic lead products division
5. Metallic foil products division

and such other and further divisions as may hereafter be created pursuant to the provisions of this Code.

Section 8. The term "association" as used herein includes the "Lead Industries Association," an unincorporated membership society organized under the laws of the State of New York and having its principal office at 420 Lexington Avenue, New York City, and such other trade associations as may hereafter participate in the activities under this Code or in the selection of the Code Authority.



CLINTON H. CRANE
President, St. Joseph Lead Company
Code Authority Member

Section 9. The term "executive committee" as used herein shall mean the executive committee of the Lead Industries Association.

Section 10. The term "Secretary" as used herein shall mean the Secretary of the Lead Industries Association, who also shall be the Secretary of the Code Authority.

Section 11. The term "Southern District" as used herein shall include the States of Texas, Mississippi, Alabama, Louisiana, and Florida.

ARTICLE III

Hours of Labor

Maximum Hours

Section 1. No employee shall be permitted to work in any division of the Industry in excess of forty (40) hours per week, or in excess of eight (8) hours in

any twenty-four (24) hour period except as herein otherwise provided. A normal work day shall not exceed eight (8) hours.

The interpretation of the eight (8) hour provision for the Mining Division in each state shall be in accordance with any laws of such state pertaining to the eight (8) hour day on mining operations.

The Code Authority shall study the operation of the eight (8) hour provision for the Mining Division and not later than ninety (90) days from the effective date shall report fully to the Administrator the results of such study. The Administrator may, at his discretion, appoint an impartial investigator, who shall review the conditions in the Mining Division of the Industry concerning the operation of the eight (8) hour provision and shall report thereon to the Administrator not later than ninety (90) days from the effective date and forward a copy of such report to the Code Authority.

Hours for Clerical and Office Employees

Section 2. No person employed in clerical or office work shall be permitted to work in excess of forty (40) hours in any one (1) week, except that during any one (1) week in a one (1) month period such employee shall be permitted to work a maximum of forty-eight (48) hours in any such week. A normal work day shall not exceed eight (8) hours.

Exceptions as to Hours

Section 3. The limitation as to hours of labor as specified in Sections 1, 2, and 4 of this Article III shall not apply to the following:

(a) To employees engaged in emergency maintenance, or emergency repair work involving breakdown or protection of life or property; provided that in such special cases not less than one and one-half (1½) times the normal wage rate for any em-

FRANCIS H. BROWNELL
Chairman of the Board,
American Smelting & Refining Company
Code Authority Member

ployee so employed shall be paid for all hours worked in excess of forty (40) hours in any one (1) week.

(b) Nor in the case of the Mining Division shall it apply to hoist men, power house men, or pump men, provided the total working hours of such employees shall not exceed forty-eight (48) hours in any one (1) week.

(c) Nor to employees receiving not less than thirty-five (35) dollars per week in a managerial, executive, or supervisory capacity, or to technical staffs; nor to outside sales or service employees.

(d) Watchmen may be permitted to work fifty-six (56) hours in any one (1) week period, provided that such employees shall have at least one (1) day's rest in each seven (7) day period.

(e) There may be a tolerance of 10 per cent additional hours over the forty (40) hours in any one (1) week for employees engaged in the preparation, care and maintenance of machinery and production facilities, stock and shipping clerks and truckmen engaged in outside delivery and pick-up service; provided, however, that at least one and one-half (1½) times the normal wage rate for any employee so employed shall be paid for all hours worked in excess of forty (40) hours in any one (1) week, or eight (8) hours in any one (1) day.

(f) The limitation as to maximum hours of work shall not apply to very special cases where restriction of hours of labor of skilled workers in continuous processes would unavoidably reduce or interrupt production because of demands inherent and peculiar within the process itself; provided, however, that such employees in such special cases shall not work more than forty-eight (48) hours in any one week, and provided that in such special cases at least one and one-half times the normal wage rate shall be paid to any employee so employed for hours worked above forty (40) hours per week, or eight (8) hours per day. Such special cases, however, shall be reported to the Code Authority. The limitation of hours does not apply where one employee is acting in temporary relief for a fellow employee in continuous processes.

(g) During any period in which a concentrated demand upon any division of the Industry, except mining, shall place an unusual and temporary burden for production work upon its facilities or to meet seasonal peak requirements or emergencies, an employee of any such division may be permitted to work not more than forty-eight (48) hours per week in not more than six (6) weeks in six (6) months of any calendar year, provided that not less than one and one-half times the normal wage rate shall be paid to any employee so employed for hours worked above forty (40) hours per week or eight (8) hours per day. All such overtime worked shall be reported to the Code Authority.

Standard Week

Section 4. No employee shall be permitted to work more than six (6) days in any seven (7) day period.

Employment by Several Employers

Section 5. No employer shall knowingly permit any employee to work for any time which, when totaled with that already performed with another employer or employers in this Industry, exceeds the maximum permitted herein.

ARTICLE IV

Wages

Minimum

Section 1. The minimum wage for each division of this industry shall be as follows:

	Cents per Hour	
	Surface	Under-ground
1. Lead mining division....	40	47½c.
2. Lead smelting and refining division.....	35	
3. Lead pigments division	40	
4. Metallic lead products division	35	
5. Metallic foil products division	35	

provided that, as to the Smelting and Refining Division, in the Southern District, the minimum hourly rate shall be thirty (30) cents per hour. Minimum wages in all divisions of the Industry in effect on July 1st, 1933, which were above the minimum specified shall in no case be reduced.

The minimum rates provided for hereinabove shall be considered as the lowest hiring rates applying to totaly unskilled labor or common labor above ground in the Mining Division and totally unskilled labor or common labor in the other divisions of the Industry. In the Mining Division, the minimum hiring rate for underground common labor shall be not less than forty-seven and one-half (47½) cents per hour. Other classes of labor shall be compensated at rates above such minimums.

Clerical and Office Employees

Section 2. No accounting, clerical, office, sales, or service employees shall be paid less than Fifteen (15) Dollars per week of forty (40) hours; provided, however, that office boys and girls and messengers may be paid at a rate not less than 80 per cent of such minimum, and provided further that the number of such boys and girls and messengers so paid shall constitute not more than 5 per cent of the total number of such employees of any one (1) office of any one (1) employer, but in any case each employer shall be entitled to at least one (1) such employee. Part-time employees shall be paid an hourly rate which shall not be less than the pro rata amount of the wages specified hereinabove.

Piecework Compensation—Minimum Wages

Section 3. This article establishes a minimum rate of pay which shall apply, irrespective of whether an employee is actually compensated on a time rate, piecework, or other basis.

Female Employees

Section 4. Female employees performing substantially the same work as male employees shall receive the same rate of pay as male employees, and when they displace male employees they shall receive the same rate of pay as the men they displace.

Wages Above the Minimum

Section 5. Equitable adjustments in all pay schedules of employees above the minimum fixed in this Code shall be made within thirty (30) days after the effective date of this Code by any employer who has not heretofore made such adjustments under the National Industrial Recovery Act. In no event, however, shall hourly rates be reduced. Within sixty (60) days after the effective date of this Code, each member of the Industry shall make a report of such adjustments whether made prior to or subsequent to the date of approval of this Code to the Code Authority.

Handicapped Persons

Section 6. A person whose earning capacity is limited because of age, physical or mental handicap, or other infirmity, may be employed on light work at a wage below the minimum established by this Code if the employer obtains from the State Authority, designated by the United States Department of Labor, a certificate authorizing such person's employment at such wages and for such hours as shall be stated in the certificate. Such authority shall be guided by the instructions of the United States Department of Labor in issuing certificates to such persons. Each employer shall file monthly with the Code Authority a list of all such persons employed by him, showing the wages paid to, and the maximum hours of work for such employee.

Apprentices

Section 7. Employment of apprentices at rates of compensation below the mini-

FRED M. CARTER
President, National Lead Company
Code Authority Member

mum provided herein shall be permitted where they are apprenticed to an employer by an indenture made pursuant to the laws of the state in which such service is to be performed, under any apprentice system established and maintained by such employer, provided such indenture agreements are filed with the Code Authority. Employers shall not be allowed to have apprentices exceeding 5 per cent of the total number of skilled craftsmen of their special class, except that each employer shall be entitled to employ at least one such employee. In no case shall an apprentice be paid less than the minimum wage provided in Section 1 of Article IV in states which do not have laws governing apprentices.

Payment of Wages

Section 8. An employer shall make payment of all wages in lawful currency, or by negotiable check therefor, payable on demand. These wages shall be exempt from any payments for pensions, insurance or sick benefits other than those voluntarily paid by the wage earners or required by the State Laws. Pay periods for wages shall be at least semi-monthly and for salaries at least once per month. Employers shall not withhold wages except as otherwise provided by law.

ARTICLE V

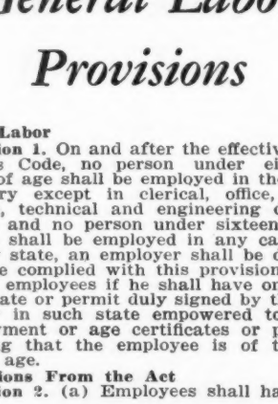
General Labor Provisions

Child Labor

Section 1. On and after the effective date of this Code, no person under eighteen years of age shall be employed in the Lead Industry except in clerical, office, sales, service, technical and engineering departments, and no person under sixteen years of age shall be employed in any capacity. In any state, an employer shall be deemed to have complied with this provision as to age of employees if he shall have on file a certificate or permit duly signed by the Authority in such state empowered to issue employment or age certificates or permits showing that the employee is of the required age.

Provisions From the Act

Section 2. (a) Employees shall have the



RALPH M. ROOSEVELT
Vice-President, Eagle-Picher Lead Company
Code Authority Member

right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

(b) No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing, and

(c) Employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment approved or prescribed by the President.

Reclassification of Employees

Section 3. No employer shall reclassify employees or duties of occupations performed or engage in any other subterfuge for the purpose of defeating the purposes or provisions of the Act or of this Code.

Standards for Safety and Health

Section 4. Every employer shall make reasonable provision for the safety and health of his employees at the place and during the hours of their employment. Standards of safety and health for each division of the Industry shall be submitted to the Administrator by the Code Authority within six (6) months after approval of this Code.

State Laws

Section 5. No provision in this Code shall supersede any State or Federal Law which imposes on employers more stringent requirements as to age of employees, wages, hours of work, or as to safety, health, sanitary or general working conditions, or insurance or fire protection, than are imposed by this Code.

Posting

Section 6. All employers shall post and keep posted complete copies of this Code and all amendments thereto in conspicuous places accessible to employees.

Company Town and Stores

Section 7. Employees other than maintenance or supervisory men, or those necessary to protect property, shall not be required, as a condition of employment, to live in homes rented from the employer. No employee shall be required, as a condition of employment, to trade at a store owned or specified by an employer.

Dismissal for Complaint

Section 8. No employee shall be dismissed by reason of making a complaint or giving evidence with respect to a violation of a code.

ARTICLE VI

Organization, Powers and Duties of the Code Authority

Organization and Constitution

Section 1. A Code Authority is hereby constituted and shall consist of the members of the Executive Committee of the Lead Industries Association, the Secretary of said Association, and such division chairmen who have respectively been elected to such office by such divisions in an equitable manner, approved by the Administrator, so as to be truly representative of such divisions respectively, and who are not members of the Executive Committee. In addition to membership as above provided there may be one to three members, without vote and without compensation by the Industry, to be appointed by the Administrator to serve for such terms from the date of appointment as he may specify. On the effective date of this Code the voting members of the Code Authority shall consist of eleven members, but such number is subject to variation due to the contents of the foregoing provision. It is contemplated that supplementary codes of fair competition not inconsistent with this basic code will be adopted for each division of the Industry. When and if such supplementary codes are submitted and approved they shall contain provisions for a Divisional Code Authority selected in an equitable manner so as to be truly representative of such division of the Industry subject to the approval of the Administrator, to administer the provisions of this basic Code which relates to such division, and the provisions of such supplementary code, and in addition this basic Code Authority may delegate such of its powers and duties as it deems necessary to such division Code Authority of such supplementary Code; provided, however, that any interested party shall have a right of appeal from any act or decision of such divisional Code Authority to the Code Authority of this basic Code.

Section 2. Each trade or industrial association directly or indirectly participating in the selection or activities of the Code Authority shall (1) impose no inequitable restrictions on membership, and (2) submit to the Administrator true copies of its Articles of Association, By-Laws, Regulations, and any amendments when made thereto, together with such other information as to membership, organization, and activities as the Administrator may deem necessary to effectuate the purposes of the Act.

Section 3. In order that the Code Authority shall at all times be truly representative of the Industry and in other respects comply with the provisions of the Act, the Administrator may prescribe such hearings as he may deem proper, and thereafter, if he shall find that any basic Code Authority or divisional Code Authority is not truly representative or does not in other respects comply with the provisions of the Act, may require an appropriate modification in the method of selection of such Code Authority.

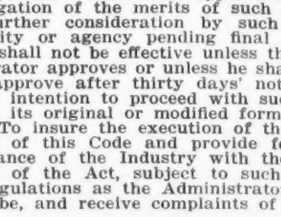
Section 4. Members of the Industry shall be entitled to participate in and share the benefits of the activities of the Code Authority and to participate in the selection of the members thereof by assenting to and complying with the requirements of this Code and sustaining their reasonable share of the expenses of its administration. Such reasonable share of the expenses of administration shall be determined by the Code Authority, subject to review and approval by the Administrator, on the basis of volume of business and/or such other factors as may be deemed equitable.

Section 5. Nothing contained in this Code shall constitute the members of the Code Authority partners for any purpose. Nor shall any member of the Code Authority be liable in any manner to anyone for any act of any other member, officer, agent or employee of the Code Authority. Nor shall any member of the Code Authority, exercising reasonable diligence in the conduct of his duties hereunder, be liable to anyone for any action or omission to act under this Code, except for his own willful misfeasance or non-feasance.

Powers and Duties

Section 6. Subject to such rules and regulations as may be issued by the Administrator, the Code Authority shall have the following further powers and duties, the exercise of which shall be reported to the Administrator and shall be subject to his right, on review, to disapprove, after such hearing as he may prescribe, any action taken by the Code Authority. If the Administrator shall determine at any time that any action of the Code Authority or any agency thereof is unfair or unjust or contrary to the public interest, the Administrator may require that such action be suspended to afford an opportunity for investigation of the merits of such action and further consideration by such Code Authority or agency pending final action which shall not be effective unless the Administrator approves or unless he shall fail to disapprove after thirty days' notice to him of intention to proceed with such action in its original or modified form.

(a) To insure the execution of the provisions of this Code and provide for the compliance of the Industry with the provisions of the Act, subject to such rules and regulations as the Administrator may prescribe, and receive complaints of viola-



F. Y. ROBERTSON
Vice-President, United States Smelting, Refining & Mining Company
Code Authority Member

tions of this Code and disputes arising thereunder, except as otherwise hereinafter provided for in subsection (h) of this section, make investigations thereof at their own instance, provide hearings thereon, adjust such complaints and make such decisions as are necessary thereon and to interpret the provisions of the Code and to bring violations of this Code to the attention of the Administrator for prosecution, recommendation and other action.

(b) To adopt by-laws and rules and regulations for its procedure and for the administration and enforcement of the Code. The Code Authority shall promptly furnish to the Administrator true copies of the by-laws, rules and regulations adopted pursuant to this paragraph.

(c) To obtain from members of the Industry, through a confidential agency, such statistical information and reports as are required for the administration of the Code and to provide for submission by members of the Industry of such statistical information and reports as the Administrator may deem necessary for the purposes recited in Section 3 (a) of the Act, which information and reports shall be submitted by members of the Industry to such Federal and/or State agencies as the Administrator may designate; provided that nothing in this Code shall relieve any member of the Industry of any existing obligations to furnish reports to any government agency. No individual reports submitted to the Administrator and/or such government agencies as the Administrator may designate, shall be disclosed to any other member of the Industry or any other party except to such government agencies as may be directed by the Administrator.

(d) To use such trade associations and other agencies as it deems proper for the carrying out of any of its activities provided for herein, provided that nothing herein shall relieve the Code Authority of its duties or responsibilities under this Code and that such trade associations and agencies shall at all times be subject to and comply with the provisions hereof.

(e) To make recommendations to the Administrator for the coordination of the administration of this Code with such other codes, if any, as may be related to the Industry.

(f) To cooperate with the Administrator

in regulating the use of any N.R.A. insignia solely by those members of the Industry who have assented to, and are complying with, this Code.

(g) To call meetings of any division of the Lead Industry to consider control of production through voluntary agreement, and to recommend to the Administrator such measures as have been voluntarily agreed upon covering fair trade practices, industrial planning, and production control, including stabilization of employment and conservation of natural resources.

(h) Within 90 days after the effective date of this Code the Code Authority shall submit to the Administrator for his approval a plan for the establishment of a National Industrial Relations Board for the Industry, consisting of an equal number of representatives of employers and employees. Provision shall be made in such plan for division of the country into districts and the creation of regional industrial relations boards to comprise an equal number of representatives of employers and employees truly representative of such districts. The creation and functioning of these boards, including the selection of representatives of employees, shall be in accordance with Section 7 of the Act. Provision shall also be made for the appointment of an impartial person on each board, national and regional, to vote only where such board is unable to render a majority decision. This plan shall provide that the regional boards shall have the authority to hear and adjudicate all complaints and disputes arising out of Articles III, IV and V of the Code, and the National Industrial Relations Board shall pass on all appeals from the regional boards solely on the basis of the record as certified by the Regional Boards to the National Industrial Relations Board. Before any such plan is approved, it shall be submitted to the Labor Advisory Board of the National Recovery Administration for their consideration and recommendations. The Administrator shall have the right, after such notice and hearing as he may specify, to review, disapprove or modify such plan and the plan shall become effective as a part of this Code when and as approved by him.

ARTICLE VII

Trade Practice Rules for Lead Pigments Division

Section 1. The following described acts shall be deemed unfair competition for Division 3 (Lead Pigments), and shall constitute a violation of this Code:

(a) Misbranding or misrepresentation of lead pigments.

(b) No member of the Industry shall give, permit to be given, or directly offer to give, anything of value for the purpose of influencing or rewarding the action of any employee, agent, or representative of another in relation to the business of the employer of such employee, the principal of such agent or the represented party, without the knowledge of such employer, principal or party. This commercial bribery provision shall not be construed to prohibit free and general distribution of articles commonly used for advertising, except so far as such articles are actually used for commercial bribery as hereinabove defined.

(c) Inducing or in any manner attempting to induce a breach, default or cancellation of a contract between a competitor and his customer during the term of such contract.

(d) Guaranteeing for a definite time the life and/or service of lead pigments.

(e) Making false or derogatory statements with respect to the prices, policies, products, practices, business, or credit of any competitor.

(f) No merchandise shall be sold at a concession, or used as an inducement, to influence the sale of any lead products, nor shall any concession be given in the price or terms of sale of a lead product to influence the sale of any other merchandise.

Section 2. Each member of the Industry engaged in the manufacture and sale of lead pigments shall file with the Secretary within ten (10) days after the effective date of this Code, a list of the prices at which his products will be sold and a memorandum of any of his conditions of sale at variance with those set forth in Schedule "A"[1] which is attached hereto and which is made a part hereof. Any change in prices or conditions of sale shall be reported to the Secretary in such manner as to reach his office within twenty-four (24) hours after the effective date of such change. Any member making a sale or quotation, which does not conform to the basis he then has on file, shall notify the Secretary in detail by letter mailed within twenty-four (24) hours. The information supplied the Secretary shall be re-issued immediately to the reporting members.

Section 3. Each member of the Lead Pigments Industry, as defined in Article II, shall submit promptly to the Secretary the following periodic reports for compilation and re-issuance in such manner as may be determined by the Division:

(a) Monthly reports of total production.

(b) Stocks on hand of finished merchandise at the beginning of each month.

(c) Monthly reports of total shipments.

ARTICLE VIII

Trade Practice Rules for Metallic Lead Products Division

Section 1. The following described acts shall be deemed unfair competiton for Division 4 (Metallic Lead Products), and shall constitute a violation of this Code:

FELIX E. WORMSER
Secretary, Lead Industries Association
Code Authority Member

(a) No member of the Industry shall give, permit to be given, or directly offer to give, anything of value for the purpose of influencing or rewarding the action of any employee, agent or representative of another in relation to the business of the employer of such employee, the principal of such agent or the represented party, without the knowledge of such employer, principal or party. This commercial bribery provision shall not be construed to prohibit free and general distribution of articles commonly used for advertising, except so far as such articles are actually used for commercial bribery as hereinabove defined.

(b) Making allowance for sales promotion and advertising in excess of actual amount expended, or making excessive expenditures on behalf of or for the benefit of a customer.

(c) Misbranding or misrepresenting the percentage or quality of various metals in any products.

(d) No member of the Division shall secretly offer or make any payment or allowance of a rebate, refund, commission, credit, unearned discount or excess allowance, whether in the form of money or otherwise.

(e) Accepting orders guaranteed against a decline in price.

(f) Making false or derogatory statements with respect to competitors' prices, policies, products, practices, business or credit.

(g) Giving any other product at a concession in price or giving it away free, in order to influence the sale of any lead product.

(h) Changing prices after the award of a contract and specifically, but without limitation, cancelling any undelivered portion of a contract for the purpose of effectuating a new contract with the buyer when the purpose of such cancellation is to create an unfair price advantage for a member of the Industry.

(i) Contracting for unspecified quantities at a fixed price or giving options at fixed prices for unspecified quantities.

(j) Inducing or in any manner attempting to induce a breach, default or cancellation of a contract, between a competitor and his customer, during the term of such contract.

(k) Taking back obsolete material or material damaged not by the vendor's fault at any value other than its value as secondary material.

Section 2. The following unfair trade practices apply to the Type Metal Business only:

(a) Attaching drum tags to competitors' dross drums without receiving authority to do so from the prospect or customer.

(b) Failing to return competitors' drums to their owner within a period not exceeding thirty days from time of their receipt.

ARTICLE IX

Trade Practice Rules for Metallic Foil Products Division

Section 1. The following described acts shall be deemed unfair competition for Division 5 (Metallic Foil Products) and shall constitute a violation of this Code:

(a) No member of the Division shall publish untruthful advertising nor shall any member in any way misrepresent any goods or credit terms.

(b) No member of the Division shall knowingly withold from or insert in any quotation or invoice any statement that makes it inaccurate in any particular.

(c) No member of the Division shall secretly offer or make any payment or allowance of a rebate, refund, commission, credit, unearned discount or excess allowance, whether in the form of money or otherwise.

ARTICLE X

Export Trade

No provision of this Code relating to prices or terms of selling, shipping or marketing, shall apply to export trade or sales or shipments for export trade, or transactions in the foreign commerce of the United States.

ARTICLE XI

Application of Code To Operations Wherein Other Metals Are Produced

Section 1. If any member of the Industry is also a member of any other Industry, provisions of this Code shall apply only to that portion of its business which is a part of the Lead Industry.

Section 2. Where there is any question as to whether lead is the major production from the operations which do or which might produce lead, zinc, copper, gold, silver or other materials, then in any and every such event the question as to which Code of Fair Competition shall govern such operations of any such member of this Industry, shall be referred to a Coordination Committee. This Coordination Committee shall be composed of two members to be appointed by each of the Code Authorities for such industries as may be involved in each particular question. In the event such Committee is unable to reach a majority conclusion, then either the Committee shall elect an additional impartial member or upon their failure so to agree on such additional impartial member, the Administrator then may appoint such additional impartial committee member. Any member of the Industry, the operations of which may raise such a question, shall file a statement of fact with the Code Authority for its Industry, and such statement shall contain a statement of its preference as to the Code it would prefer to have such operations be governed by, and such preference shall be granted unless such Coordination Committee shall find that the granting thereof would be unfair in view of the

[1]Schedule "A," which is not reproduced here, consists of three articles that set forth (1) conditions for sale of lead oxides in lots of less than twenty tons; (2) conditions for sale of lead oxides in lots of at least twenty tons; (3) conditions for sale of basic lead carbonate (dry white lead).

rights of others or that it would have a tendency contrary to the effectuation of the policies of the Act. Any action taken by the Coordination Committee shall be referred to the Administrator and shall be subject to his disapproval.

Section 3. Within ten (10) days after the effective date of this Code, any member of this Industry may file such a statement of fact and preference as to being governed by any of such other Codes which may at that time be in effect. Thereafter upon any such other Code becoming effective, such statement may then be filed; provided, however, that until any such statement is filed and decision is made thereon by such Coordination Committee, such operation of such member of this Industry shall be governed by the provisions of this Code.

Section 4. From time to time thereafter if conditions change, members of this Industry shall be entitled to file such statements of fact and preference as to change of a portion of their operations from the jurisdiction of one Code to the jurisdiction of another, and in such event they shall be handled in the same manner as provided for above.

Section 5. The foregoing Sections 1 to 4 inclusive of this Article XI, shall not be effective until Codes of Fair Competition for the copper and zinc industries, containing an Article substantially the same as this Article XI, have been approved, and are in effect, and certified copies of such approved codes have been filed with the Code Authority for this Industry.

ARTICLE XII

Modification

Section 1. This Code and all the provisions thereof are expressly made subject to the right of the President, in accordance with the provisions of Subsection (b) of Section 10 of the Act, from time to time to cancel or modify any order, approval, license, rule or regulation issued under said Act, and specifically, but without limitation, to the right of the President to cancel or modify his approval of this Code, or any conditions imposed by him upon his approval hereof.

Section 2. Such of the provisions of this Code as are not required to be included therein by the Act may, with the approval of the Administrator, be amended as provided in Section 3 hereof in such manner as may be indicated by the needs of the public, by changes in circumstances, or by experience; all the provisions of this Code, unless so modified or eliminated, shall remain in effect until the expiration date of Title I of the Act.

Section 3. An amendment to this Code or any Codes supplemental thereto affecting or pertaining to the several divisions of the Lead Industry may be proposed by any interested party either to the divisional Code Authority, the basic Code Authority, or directly by or to the Administrator. All such proposed amendments shall be referred to the division affected or interested and then shall be submitted by said division to the basic Code Authority who shall give Members of the Industry an opportunity to be heard thereon, and thereafter the Code Authority may make such recommendations thereon as are deemed proper; provided, however, that when approved by the Administrator as necessary to effectuate the policies of the Act, after such notice and hearing as he may prescribe, any proposed amendment shall thereupon become effective as a part of this Code.

ARTICLE XIII

Monopolies

No provision of this Code shall be so applied as to promote monopolies or monopolistic practices, or to eliminate, oppress, or discriminate against small enterprises.

ARTICLE XIV

Effective Date

This Code shall become effective beginning the second Monday after its approval by the Administrator.

Rehabilitation of Old Properties Increases . . . More New Mills

REHABILITATION of abandoned mining properties is increasing as the possibilities of old workings under the prevailing higher prices for gold and silver are more clearly recognized. This trend is responsible for the construction of much new surface plant, particularly new mills, in many of the mining districts. Interest in dredging and placer ground is likewise widespread, and the Natomas Company is reported to be planning the construction of a new dredge near Citrus Station, Calif. Base-metal operations continue at about the same level as in the preceding month, with prospects improving as codification of these industries proceeds.

A code of fair competition for the lead industry (see pages *267-272*) and one for the manganese industry were approved during the past month. The code for the manganese industry establishes a 40-hour work week and minimum wages for common labor of 40c. per hour above ground and 47½c. underground, in the Northwestern section of the country; 40c. above ground and 45c. underground in the Northern section, and 30c. above ground and 35c. below ground in the Southern section. Office workers are to be paid a minimum of $15 per week.

A summary follows of the more important developments last month in the various mining districts.

Utah

Chief Consolidated Mining plans to start by July 20 its new program of development at its Apex Standard mine, in the Tintic district, near Eureka. Both No. 1 and No. 2 shafts are being repaired preparatory to driving a connection for ventilation. No. 1 shaft has been put in condition for operation down to a point below the 600 level, leaving less than 300 ft. of this work to be completed before reaching the bottom at the 900 level. The company plans to prospect the Eureka Standard fissure in the quartzite, which, in the adjoining Eureka Standard property of Tintic Standard Mining, has been a producer of gold ore.

A tunnel has been started to prospect the gold ore discovery made on the E & K property, 4½ miles northeast of Tooele in Settlement Canyon. At this point a fissure, traversing the Jordan and Commercial limestones, has been opened up which carries gold ore of good grade. A 1,400-ft. gravity tramway has been erected, according to J. R. Walker, manager, to expedite development. Leasers have a crew of ten men at work.

Two agitators of the Devereaux type —15x20 ft., 60-in. impellers, 16 hp., 80 r.p.m.—have been installed at the Manning cyanide plant of Manning Gold Mining, at Manning, 5 miles south of the Mercur gold district. Capacity has been increased to 400 tons daily. Mill heads are averaging about $4.50 a ton, and recovery is about 50 per cent. The company is meeting the shortage of water caused by the drought, with its new 5-mile pipe line that conveys water from the Fairview reservoir.

Mount Hillyer Gold, owning property in the Henry Mountains, 100 miles southeast of Greenriver, is preparing to drive a tunnel, at an additional depth of 600 ft., to cut the orebodies opened in an upper tunnel. Buildings have been erected and a blacksmith shop has been provided. In the upper tunnel 1,400 tons of gold ore of good grade has been exposed, according to Clark L. Whitney, Salt Lake broker, who is heading the development company.

Development is being carried on at the adjoining Bromide Mining property. Henry Gold Mining is about to start development on its claims.

American Smelting & Refining has awarded to the Rust Engineering Company, of Pittsburgh, Pa., a contract covering the erection of a 405-ft. stack for fumes from the roaster and copper reverberatory furnaces at its Garfield smelter. The new stack, to be constructed of reinforced concrete and lined with firebrick, will cost $115,000. Inside diameter of the stack will be 27 ft. at the top. Excavation for the stack foundation has been started by the smelting company. Construction is to be completed within four months. The stack will replace one that has been in operation since 1905, when the Garfield plant was built.

High-grade lead-silver ore has been struck in the Cardiff mine, in Big Cottonwood Canyon, 25 miles southeast of Salt Lake City. The new find occurs in a limestone bed on a shale limestone contact above the 350 level. A raise has been driven 30 ft. in the ore, which ranges from 2 to 3½ ft. in thickness. In one place, the ore is 19 ft. wide, with the boundaries still undetermined on either side. The company believes that early this month the road will be open for shipment of about 800 tons of ore accumulated at the property. Some ore, mined by leasers, has been shipped from the Little Cottonwood side of the property. Four sets of leasers, according to Lynn Thompson, manager, are mining ore on the 700 level.

A winze that is being sunk on the East Crescent fissure in the Park City Consolidated Mining property at Park City has penetrated a highly mineralized formation for nearly 100 ft., indicating that a new productive area exists 1,400

American Flag property of the Park City Development Company, in the Park City district, Utah, where gold ore of good grade is reported to have been encountered recently on the 1,100 level. The American Flag lies between the Silver King Coalition and the Park Utah Consolidated properties

ft. south of the two veins which are now producing daily about 80 tons of gold-silver ore of good grade. Galena and zinc blende also occur with the vein quartz, a condition markedly similar to that prevailing on the fringe of the ore-bodies in the productive Roosevelt and Silver veins, to the north. Stopes in the Silver and the Roosevelt veins are producing steadily.

A tunnel is being driven in the Centennial Eureka dump, at Eureka, under the direction of Dan Atherley, leaser, to reach ore discharged onto the dump as waste in the early days. A 600-ft. conveyor belt, driven by a gasoline engine, has been installed to move the waste out of the tunnel. A number of carloads of dump ore have been shipped by Mr. Atherley, who has a crew of nine men at work.

California

Carson Hill Gold Mining, according to reports from Melones, plans to enlarge its mill at Melones to 1,000 tons' daily capacity by installing cone crushers and adding new equipment to the cyanide plant. The present mill is being operated at full capacity on low-grade gold ore composed of mineralized schist with some quartz. About 20,000 tons of ore are treated a month. Mining operations are carried on at the old Carson Hill-Melones mine in the glory hole and the underground workings above the 1,600-ft. level, the ore being hauled to the mill by electric trains through the Melones tunnel. Ore from the Calaveras vein is mined at the surface by a power shovel and hauled by trucks to a loading bin, from which it is transferred to the main haulage cars. Large bodies of ore are being exposed by development.

Natomas Company is said to be planning construction of a new gold placer dredge near Citrus Station, on the Sacramento-Folsom Highway.

Silver-Lead Syndicate, headed by J. J. Beeson, Salt Lake consulting geologist, has taken a 25-year lease on the old Cerro Gordo mine, in the Cerro Gordo district, near Keeler, Inyo County. A drift is being extended on the 200 level to prospect for the extension of a faulted silver-lead orebody.

Mountain Copper has acquired the Big Canyon mine near Shingle Springs, Eldorado County, after completing an extensive sampling and drilling campaign. Preliminary rehabilitation and development work is in progress to prepare the mine for early production. Present plans also include erection of a mill.

Other mines in course of rehabilitation in Eldorado County are the Church and German mines, near El Dorado, purchased recently by Utah Apex Mining, which company also operates the Montezuma mine, at Nashville, and the old Idaho mine, five miles north of El Dorado. Clean-up work is being carried on at the Church and German Mines preparatory to installation of mining machinery. Rumors prevail to the effect that the Pacific mine, at Placerville, is to be reopened soon.

Pennsylvania Mining & Investment is rehabilitating the historic Pennsylvania mine, at Browns Valley, Yuba County, and plans to sink the old 195-ft. shaft to 300 ft. Albert Burch, of Medford, Ore., is consulting engineer, and H. W. Whiting, mine superintendent.

A substantial orebody is said to have been opened on the 1,000-ft. level in the Central mine of Lava Cap Mining, according to reports from Nevada City. The company also operates the Banner mine, adjacent to the Central mine, and recently placed a 200-ton mill in operation. Otto E. Schiffner is general manager.

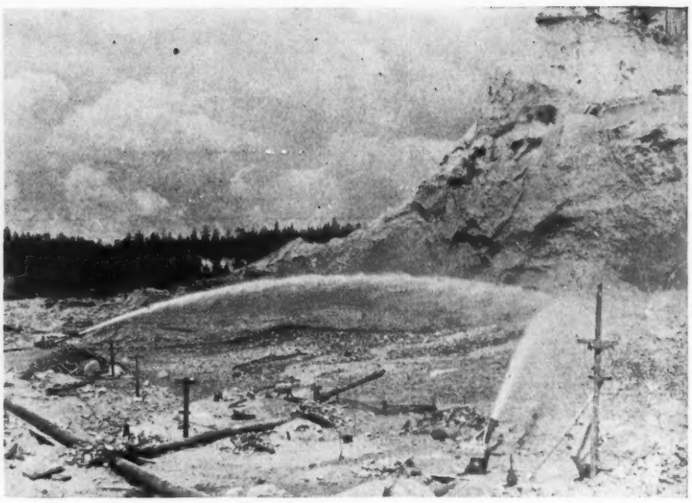
Nevada

Three projects of major scope are noted in the Como district, 15 miles south of Comstock. Como Mines is driving two 8x8-ft. laterals from its 3,500-ft. main haulage tunnel that are expected to cut four or more gold-silver veins within the next 90 days at depths of 600 to 650 ft. Stone Cabin Consolidated, to the north, is completing a 200-ton flotation mill, and, according to estimates of Frank W. Royer, advisory engineer, has 600,000 tons of mill ore above its winze level. Greeley Gold & Silver, headed by H. G. Snyder and Reed Smoot, of Salt Lake City, is installing a compressor and starting a three-compartment shaft on its group of 100 claims. The district has many large veins, oxidation extends rarely to more than 150 ft., and the mines will supply all the water required for milling operations.

Lucky Tiger-Combination has again secured an option on the Buckskin National mine, in northern Humboldt County. Lucky Tiger worked the mine last year, but forfeited its option, and another was granted to the Halifax-Tonopah. Later the option was transferred to Goldfield Consolidated Mines, by which it was relinquished on May 1.

Mountain City Copper, developing the Rio Tinto copper mine in Elko County, was said by J. O. Elton, manager for International Smelting, to have a reserve of 400,000 tons above the 400-ft. level of the new shaft. Of this total, 50 per cent will be shipped by truck to the Tooele smelter, in Utah, and the remainder will be concentrated at the mine. Sinking, interrupted by the caving of ground at the 400-ft. level, has been resumed with the purpose of driving laterals at the 600-ft. level. The ore is said to be of lower grade in the sulphide zone, below 350 ft., but the full extent of the deposit has not been determined. Extensive diamond drilling has failed to reveal any ore of value outside Mountain City's boundaries.

Shipments of gold ore have been going to the International smelter in considerable volume from company and lease workings on properties of Copper Canyon Mining, in Copper Canyon, and Copper Basin, in Lander County. Recent shipments have been coming from the 200-ft. level of the Copper Canyon mine, south of the old copper workings, where two faces of gold ore are exposed. A large body of excellent mill ore is being developed on the 100-ft. level of the Spring Valley mine, two miles below Silver City, at the south-



A California Hydraulic Operation

Property of Omega Hydraulic, in the Nevada City district, California. Left—Sluice conveying "high-head" water for use in the "giants." Right—Pit, with "giants" in operation. Some idea of the height of the pit face may be gained by noting the surface growth in the upper right-hand corner

ern end of the Comstock district. The property is said to have produced a little rich gold ore from surface cuts, but the vein outcrop gave no indication of its importance. H. B. Bulmer, veteran Comstock operator, induced members of the Dayton syndicate, operating the Dayton mine and 150-ton cyanide mill, to purchase the Spring Valley. He sank the shaft 100 ft. on a minor cross fissure, drove to the vein, and extended drifts both ways, opening ore that is being trucked to the Dayton mill. The discovery is accounted one of the most notable in the district in many years.

Castle Peak Quicksilver, north of Virginia City, has completed a shaft to a depth of 340 ft., or 190 ft. below the level of the mill adit. The shaft will make available for stoping a block of ore of good grade below stopes that have yielded a highly profitable output. With any appreciable advance in the market price of quicksilver, said H. E. Loufek, president and manager, the Gould furnace on the property will be recommissioned.

A crew of men is engaged in prospecting and sampling the Esmeralda group of claims, at Aurora, part of the large area owned by Aurora Consolidated, which in turn is owned by Goldfield Consolidated Mines. The latter company bought the mine and newly finished cyanide mill from Jesse Knight, of Utah, in 1914 and discontinued work in 1918. The Esmeralda ground is about two miles from the old workings. R. N. Witt, geologist, and E. A. Julian, manager for Goldfield Consolidated, have spent some time on the ground, and if prospecting results are favorable some development work will probably be started by the company.

Reopening of the old Duplex mine, at Searchlight, has been undertaken by Thomas Copeland and James Knight, who will seek the extension of oreshoots below the 800-ft. level.

Two cars of high-grade ore have been shipped from the Buck & Charley mine, at Lower Rochester, Pershing County, which had been closed down since 1921. Charles Mayer, manager, has opened a rich section of vein in new ground. The project is financed by New York interests.

Mining and milling operations at the camp of Midas, Elko County, which have been stimulated by the high price of gold, have been handicapped recently by the unusual drought conditions prevailing in Utah, Idaho, and Nevada. East Standard Mining, headed by Harry S. Joseph, manager, is preparing to sink a well 300 ft. to develop water for the mill. A Keystone drill has been brought in from Ely, and an 8-in. hole will be put down. The company recently equipped its mill with a Blake type crusher, a 15-hp. fuel-oil engine, automatic ore feeders, a 10-ft. Lane mill, a Gibson amalgamator, and corduroy concentrating tables of the South African type. About 500,000 tons of gold ore of good grade is said to have been blocked out. Capacity of the mill is 60 tons daily.

Arizona

A bullion shipment valued at $70,000, the clean-up from two months' operation, was made in May at the Katherine mill, 30 miles west of Kingman, on the Colorado River. The mill is operated by Gold Standard Mines, and treats gold-silver ores produced at the Tyro, Roadside, and Arabian mines. Value of the mill concentrate averages about $1,200 per day. Eighty men are employed at the plant, the capacity of which will probably be increased as soon as a transmission line from Kingman is completed.

Gold mining continues to boom at Oatman, where more than twenty mines are in operation. A hoist has been placed at the main shaft of the Lexington property by Consolidated Gold Mining, the president of which company is Thomas A. Wood, of Los Angeles. L. V. Hautier and associates, working the Red Lion and Rainbow properties, have started to ship to the Big Jim mill, which is also receiving ore from the Telluride property. Other operating mines of the district are the Vivian, Oatman Eastern, Gold Dust, and Empire.

Bankruptcy and receivership troubles that caused suspension of operations at the Comstock-Dexter mine, at Hillside, for the past year have apparently been cleared up, and development work, including deepening of the shaft from 140 to 385 ft., is to be started. Equipment includes an electric power plant, electric hoist, air compressor, and modern camp buildings. Construction of a flotation mill is planned. T. F. M. Fitzgerald, of Prescott, is president of the company. Hillside Mines, 5 miles from the Comstock-Dexter, has ordered assaying equipment for the mill which it is erecting. The property is under the supervision of H. L. Williams, of Prescott.

Concentrate is being shipped from the Crown King mine, at Crown King, to the Magma smelter, at Superior, and development work is to be started at the Oro Belle property, in the same locality, which is under option to Henning Olund. A geological and geophysical survey of the old Congress mine, at Congress, will be made by International Geophysics, of Los Ange-

les. The new 60-ton mill of the Nellie Meda mine, north of Aguila, was placed in operation on May 15. The Nellie Meda is controlled by Wendon Copper, of which company Ned Creighton, of Phoenix, is president.

United Verde, at Jerome, is investigating the feasibility of recovering gold and silver from the waste dumps resulting from stripping operations in the open pit. Flotation and cyanide tests are being made.

Precious-metal properties near Dos Cabesas are receiving the attention of Canadian and British interests which control Ventures, Ltd. Major James G. L. Howard is directing the examination work. Consolidated Gold Mines, an Arizona corporation, is also developing 32 claims in the Dos Cabesas district. A crosscut intersecting six veins has been driven 1,700 ft., and drifts are being driven along several of the veins. A 50-ton flotation plant has been erected. Other properties in the district on which exploration work is planned are the Last Chance, a group of five claims; the Bean property, containing ten claims; the Philadelphia, an old producer; the Cottonwood, the Le Roi, and the Pedersen.

The Tombstone district shipped 26 cars of silver ore during April. Most of this ore came from the Tombstone Extension unit of American Smelting & Refining. United States Smelting, Refining & Mining has entered the Tombstone district by taking a bond and lease on the property of Tombstone Development, which company has had a number of leases working during the past year. The work will be in charge of R. C. Walker. A gold-silver-copper strike is reported to have been made at the Monte Cristo mine, near Constellation. This mine has been shipping ore direct to the smelter. Installation of a pilot mill is under way. H. B. Browning is superintendent.

Phelps Dodge has found a new orebody on the 2,200 level of its Bisbee property. The copper ore is of good grade and carries substantial amounts of gold and silver.

Michigan

Copper Range has increased its yield to about 60 lb. of copper per ton of rock treated, the highest in the Champion mine's history. This has been accomplished not by confining production to rich stopes, nor by discarding as barren any rock that contains a less than average amount of copper, but by careful hand selection of rock in the stopes. The high yield is from rock of about the same quality as that mined in recent years and leaner than the rock mined previous to 1927. As a result, costs have been kept down. Cost per pound is about 7½c., as compared with 8.64c. in 1932, and 11.60c. in 1930.

Under the terms of the Copper Code, Calumet & Hecla Consolidated's production has been cut by about a third. Wages also have been adjusted. Costs have been low, but with smaller production and a wage increase, costs will be somewhat higher during the remainder of the year. The company is mining only the upper reaches of the conglomerate bed, taking out rock from shaft pillars and backs of old stopes. This is unusually rich ground. About five or six years' more work exists in this section of the property. The deeper levels, which were closed and permitted to fill with water, will not be reopened until copper advances substantially in price. Resumption at the Centennial branch also is contingent on a higher price for the metal. Ahmeek likely would be the first branch to reopen with a better demand for copper.

The Quincy mine, which has been idle for several years, is in readiness to resume operations when copper advances to 9½c. Copper courses in the lower levels are extensive, and much heavy mass copper also exists. The mill run of rock can be selected to bring the yield up to a profitable basis. Many thousands of feet of ground are available in which no stoping has been done. The mine has been kept dry through pumping, and all openings are in good condition.

Minnesota

The iron-ore shipping season opened May 3, when the steamer "L. E. Block," of the Inland Steel Company fleet from Chicago, entered the harbor at midnight and by 9 o'clock the next morning was loaded with 10,350 tons of Dunwoody ore and on its way down the lake for South Chicago. Ore shipping has been brisk, especially with the independent companies.

The first ore boat to arrive equipped with the ship-to-shore radio phone, installed last winter, was the "Wm. C. Atwater," a 12,000-ton carrier of the Wilson Transit Line. Such equipment removes most of the uncertain element from Lake shipping.

A new application for the "electric eye" has been developed at the Scranton mine, at Hibbing, Minn. The underground section of the mine, which makes 500 gal. of water per minute, has been closed off from the open-pit section, and the water is so pure and clear that it is pumped into the village water mains. Owing to blasting in the pit, dirt occasionally drops from the back of the drifts and makes the water cloudy. To keep this water from entering the village supply, an electric eye is installed in the discharge pipe that throws open a bypass when cloudy water is pumped and lets it waste away. When the water clears the relay closes the bypass, and the water again enters the village mains.

World Production of Gold

(American Bureau of Metal Statistics)

In Fine Ounces

	Feb.	March	April
United States (*a*)	176,000	227,000	217,000
Canada	223,000	249,000	240,000
Mexico	55,000	34,000	(*f*) 50,000
Colombia	30,000	27,000	(*f*) 30,000
Other South America	50,000	53,000	55,000
British India (*e*)	25,000	26,000	26,000
Japan (*e*)	(*f*) 35,000	(*f*) 35,000	(*f*) 35,000
Queensland	6,000	12,000	(*f*) 10,000
Western Australia	52,000	46,000	(*f*) 50,000
Other Australasia (*b*)	34,000	37,000	39,000
South Africa	826,000	874,000	866,000
Belgian Congo	20,000	22,000	23,000
Rhodesia	54,000	58,000	58,000
British West Africa	30,000	32,000	33,000
Russia (*c*)	(*f*) 200,000	(*f*) 200,000	(*f*) 200,000
Elsewhere (*d*)	(*f*) 106,000	(*f*) 110,000	(*f*) 115,000
Totals	1,922,000	2,042,000	2,047,000

(*a*) Includes Philippines. (*b*) Includes New Zealand and New Guinea. (*c*) Chiefly Siberia. (*d*) Includes West Indies, Central America, Europe, and Asiatic and African lands not separately reported; estimated. (*e*) Principal mines only, but nearly complete. (*f*) Conjectural.

Tanganyika Concessions Acquires Eldoret Mining Syndicate

The importance of the Kakamega gold field, in Kenya Colony, Africa, is further attested to by the fact that Tanganyika Concessions and associated companies have decided to exercise their option for a controlling interest in the Eldoret Mining Syndicate. This option was secured more than two years ago, and since then the Tanganyika group of companies have been conducting extensive exploratory work on Eldoret's concession of 35 square miles, and on its 250 reef and 152 alluvial claims outside the concession. The companies have also purchased many other claims and secured further important concessions in the vicinity and surrounding areas. Sir Robert Williams, managing director of Tanganyika Consessions, Zambesia Exploring, and Rhodesia-Katanga, has recently completed a personal inspection of the properties under option to his companies, and the decision to purchase is the result. Equipment of some of the properties will probably be undertaken immediately, as considerable tonnages of rich gold ore are understood to have been developed.

Broken Hill Proprietary Forms Kalgoorlie Subsidiary

Kalgoorlie Enterprise Mines has been formed by the Broken Hill Proprietary to develop the Enterprise leases at Kalgoorlie. For almost two years the Broken Hill company has been carrying out exploratory work to determine whether the lodes of the Great Boulder and South Kalgurli companies dip westward into the Enterprise leases at depth.

New Occidental to Equip Mine

New Occidental Gold Mines, which has unwatered and is developing the Occidental mine at Cobar, New South Wales, Australia, plans to spend £100,000 in experimental work and in equipment.

Proposed Legislation Provides For Purchase of More Silver

IN ACCORDANCE with President Roosevelt's recommendation of May 22, Congress proceeded early in June to enact legislation that provided for an increase in the proportion of silver to gold in the monetary stocks of the country, "with the ultimate objective of having and maintaining one-fourth of the monetary value of such stocks in silver." The bill was approved in the House of Representatives on May 31 with the greatest dispatch, and treatment of similar character was expected to be accorded it in the Senate, where debate on the proposed legislation began on June 6.

The bill as approved by the House, in addition to declaring the policy of having one-fourth of the monetary reserves in silver, provides the following:

Authorizes and directs the Secretary of the Treasury to buy silver at home or abroad, but limits purchase price to the monetary value of silver and provides that silver situated in the United States on May 1, 1934, may not be purchased at a price in excess of 50c. a fine ounce.

Authorizes the Secretary of the Treasury, with approval of the President, to sell silver whenever the market price exceeds its monetary value or whenever the monetary value of the government stock of silver is more than 25 per cent of the monetary value of stocks of both gold and silver.

Authorizes and directs the Secretary to issue silver certificates against the stocks of silver accumulated.

Authorizes the Secretary of the Treasury to regulate or prohibit the acquisition, importation, exportation or transportation of silver and to require reports in connection therewith.

Authorizes the President to require delivery to the mints of silver, no matter who the owner or holder may be or where the silver may be situated, and authorizes penalties for failure to comply with silver call.

Amends the stamp tax provisions of existing law to provide a transfer tax on silver equal to 50 per cent of the difference of the cost to the transferer, plus allowed expenses, and the price received.

President's Message

The text of the President's message of May 22 to Congress follows:

TO THE CONGRESS OF THE UNITED STATES:

On January 11, 1934, I recommended to the Congress legislation which was promptly enacted under the title, "The Gold Reserve Act of 1934." This Act vested in the United States Government the custody and control of our stocks of gold as a reserve for our paper currency and as a medium of settling international balances. It set up a stabilization fund for the control of foreign exchange in the interests of our people, and certain amendments were added to facilitate the acquisition of silver.

As stated in my message to the Congress, this legislation was recommended as a step in improving our financial and monetary system. Its enactment has laid a foundation on which we are organizing a currency system that will be both sound and adequate. It is a long step forward, but only a step.

As a part of the larger objective, some things have been clear. One is that we should move forward as rapidly as conditions permit in broadening the metallic base of our monetary system and in stabilizing the purchasing and debt paying power of our money on a more equitable level. Another is that we should not neglect the value of an increased use of silver in improving our monetary system. Since 1929 that has been obvious.

Some measures for making a greater use of silver in the public interest are appropriate for independent action by us. On others, international cooperation should be sought.

Of the former class is that of increasing the proportion of silver in the abundant metallic reserves back of our paper currency. This policy was initiated by the Proclamation of December 21, 1933, bringing our current domestic production of silver into the Treasury, as well as placing this nation among the first to carry out the agreement on silver which we sought and secured at the London Conference. We have since acquired other silver in the interest of stabilization of foreign exchange and the development of a broader metallic base for our currency. We seek to remedy a maladjustment of our currency.

In further aid of this policy, it would be helpful to have legislation broadening the authority for the further acquisition and monetary use of silver.

I, therefore, recommend legislation at the present session declaring it to be the policy of the United States to increase the amount of silver in our monetary stocks with the ultimate objective of having and maintaining one-fourth of their monetary value in silver and three-fourths in gold.

The Executive Authority should be authorized and directed to make the purchases of silver necessary to attain this ultimate objective.

The authority to purchase present accumulations of silver in this country should be limited to purchases at not in excess of 50 cents per ounce.

The Executive Authority should be enabled, should circumstances require, to take over present surpluses of silver in this country not required for industrial uses on payment of just compensation, and to regulate imports, exports and other dealings in monetary silver.

There should be a tax of at least 50 per cent on the profits accruing from dealing in silver.

We can proceed with this program of increasing our store of silver for use as a part of the metallic reserves for our paper currency without seriously disturbing adjustments in world trade. However, because of the great world supply of silver and its use in varying forms by the world's population, concerted action by all nations, or at least a large group of nations, is necessary if a permanent measure of value, including both gold and silver, is eventually to be made a world standard. To arrive at that point, we must seek every possibility for world agreement, although it may turn out that this nation will ultimately have to take such independent action on this phase of the matter as its interests require.

The success of the London Conference in consummating an international agreement on silver, which has now been ratified by all the governments concerned, makes such further agreement worth seeking. The ebb and flow of values in almost all parts of the world have created many points of pressure for readjustments of internal and international standards. At no time since the efforts of this nation to secure international agreement on silver began in 1878 have conditions been more favorable for making progress along this line.

Accordingly, I have begun to confer with some of our neighbors in regard to the use of both silver and gold, preferably on a coordinated basis, as a standard of monetary value. Such an agreement would constitute an important step forward toward a monetary unit of value more equitable and stable in its purchasing and debt paying power.

FRANKLIN D. ROOSEVELT

The White House,
May 22, 1934.

World Production of Silver

(American Bureau of Metal Statistics)

	In Fine Ounces		
	Feb.	March	April
United States	1,903,000	2,791,000	2,389,000
Canada	1,351,000	1,085,000	1,015,000
Mexico	5,413,000	4,495,000	(f) 5,000,000
Peru	548,000	548,000	537,000
Other America	820,000	900,000	900,000
Europe	1,000,000	1,350,000	1,360,000
Australia refined	790,000	829,000	735 000
Other Australia and New Zealand	238,000	240,000	(f) 250,000
Burma, refined	489,000	490,000	490,000
Other Asia	700,000	725,000	720,000
South Africa	77,000	80,000	80,000
Other Africa	36,000	40,000	(f) 40,000
Total	13,365,000	13,573,000	13,516,000

For some of the countries the accounting, especially for the latest month, is preliminary and subject to revision which may be considerable. The Mexican returns, which arrive late, are difficult to estimate, owing to their irregularity. (f) Conjectural.

Mufulira Copper to Extend Mill

Mufulira Copper Mines is to increase the daily capacity of its 1,500-ton concentrator to about 6,000 tons. While building this extension it will also erect a smelting plant to treat the concentrate. When the economic depression began four years ago, Mufulira was building a concentrator rated at about 5,000 tons' daily capacity. Because of the rapidly diminishing demand for copper, and in agreement with the international production curtailment arrangement, only one section of that concentrator was completed, though much of the work had been done on the additional sections.

A characteristic prospecting shaft in the Kalgoorlie gold fields of Western Australia. More than 500 prospectors are combing the region for new deposits. State aid includes operation of stamp mills and cyanide plants, geologic studies, and mine inspection

More New Australasian Companies Formed . . . Mills Enlarged

FORMATION of Bendigo Mines, Ltd., to carry out underground exploration within an area of 2,300 acres at Bendigo, has been announced. The company is making intensive structural geological surveys under the direction of H. E. McKinstry and J. B. Stone, both American geologists.

Cocks Pioneer Gold and Tin Mines has been formed to work by hydraulic methods a large area of shallow gold alluvial at Wangaratta, Victoria.

North Enterprise Gold Mines has been formed to take a twelve months' option on a gold mining lease of 24 acres adjoining on the north the Enterprise Gold Mines leases at Davyhurst, Western Australia.

South Cross Gold Development has been formed in London to unwater, develop, and equip the Frasers mine, Coolgardie, Western Australia.

Timoni (W. A.) Gold Mine has been floated to acquire the Timoni gold mine, at Copperfield, in the Coolgardie district, Western Australia. Ore reserves to a depth of 200 ft. are said to be 20,000 tons.

To provide additional finance for Mount Isa Mines, which has been operated at a loss since operations began in May, 1931, a loan of £500,000 is being floated in Melbourne. Payment of interest and repayment of the loan are guaranteed by the Queensland Government. The company purposes to proceed with the erection of a zinc flotation section.

New Guinea Goldfields is enlarging its mill to treat 4,500 tons per month, and development of the vein system at depth is proceeding.

Mount Morgan is extending its plant to treat 5,000 tons of ore weekly.

Triton Gold Mines is carrying out underground development to a depth of 300 ft., to enable information to be obtained for the selection of the site of a new shaft. Power plant and compressors have been ordered, and a supply of water has been obtained. No work on milling treatment has yet been undertaken.

Bundi Tin Dredging is transferring one of its dredges from Malaya to New Zealand to work an area of 360 acres, 9 miles from Greymouth, South Island. The area so far proved comprises 77 acres, containing 2,955,908 cu.yd. The dredge will handle 120,000 cu.yd. per month of 24 working days.

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Mexican Mining Absorbs Large Number of Workers

Numerous workers whom it dismissed in September, 1932, owing to unsatisfactory economic conditions then prevailing, are being invited by Potosi Mining to apply for reinstatement for work in its Chihuahua unit. . . . From three to four grams of gold each are being obtained daily by Indians from placer beds along rivers in the Matias Romero region, Oaxaca, according to travelers from that area who have recently arrived at Mexico City. . . . Several rich gold and silver deposits in federal mineral reserves of Jalisco have been discovered by a commission of the Ministry of National Economy mining engineers which is tabulating deposits and abandoned mines in that State, as well as in Sinaloa and Nayarit, with a view to working them along lines similar to those employed by cooperative societies of miners in Zacatecas and Oaxaca. . . . The commission is investigating a deposit found by an Indian in the Sierra de Tacuichamona region, near the town of Quila, Sinaloa, ore samples from which have contained exceptionally large amounts of gold.

Smelters at Monterrey, Nuevo Leon, are said to be negotiating with the federal government for permits to augment the number of furnaces used for treating high-grade ores, as the result of increased work in mines of Nuevo Leon, Coahuila, Tamaulipas. . . . Cia. de Real del Monte y Pachuca, Pachuca, Hidalgo, has started working, under long term options, mineral properties at Pinos Altos, Chihuahua, owned by a Mexican syndicate, and is installing an Ingersoll-Rand compressor and engine. . . . Cia. Minera Ensenadense, S. A., backed by American interests, is testing a Lemley Bros. ore concentrator at its gold placer properties at Quitovac. . . . A 10-ton mill has been erected by the Consolidated Mines of Barranco del Oro on three mining properties it recently acquired from Walton F. Gibbs, near Ixtlan, Nayarit.

El Fraile Mining, recently organized, and La Cruz Mining, are working the old Capula mineral zone, about 20 miles west of Pachuca, Hidalgo, which Spaniards operated extensively before Mexico gained her independence, but which has been long neglected. The latter company is operating its own flotation plant, and both enterprises are shipping ores, running high in gold, to Pachuca. . . . The Oasis de Oro mine, near Bahia de los Angeles, Lower California, is shipping ore to smelters at Cananea, Sonora, instead of to those at El Paso, Texas. The first consignment to Cananea was 30 metric tons. . . . Forty per cent of the mineral lands abandoned by large companies, owing to the fact that the lands were unprofitable for them to exploit, are being worked by miners' cooperative societies, according to government announcements. Most of these lands are in Chihuahua, Durango, Sinaloa, and Oaxaca. . . . Several Nuevo Leon industrialists are examining abandoned mines with a view to working them. Prospectors are working lands near the abandoned El Penon mine, which was a large silver producer. . . . Owners of the San Juan Nepomuceno silver-lead mine, in Queretaro, which has been closed down for some time, are arranging to reopen it soon.

A profit of 10 per cent per ton of ore mined is reported by the Sociedad Cooperativa de Productores de Minerales de Guanajuato, a recently organized group of miners and owners of small mining lands working tracts near Guanajuato City. The society is mining a high-grade gold-silver ore.

Revised Canadian Gold Tax Meets Objections to Early Proposals

Dominion's Export Trade in Metals Increases Steadily—Aldermac Prepares To Enlarge Mill—Porcupine Area Scene of New Search for Ore—Hottah Lake Find Surpasses Great Bear Lake Deposit

IMPOSITION of a 25 per cent tax on the "unearned increment" in the price of gold (to use Premier Bennett's phrase) has met practically all the objections raised against the originally proposed 10 per cent flat tax on gold output. The new tax is being paid by eleven gold-mining companies: seven in Ontario, two in Quebec, and two in British Columbia. As all gold must be shipped to the mint at Ottawa, the amount of the tax in each instance is deducted from the return made by the mint to the shipper.

The only visible effect at present of the tax is the probability that dividends will be reduced somewhat, though each of the companies concerned has a large earned surplus that could be used to avoid this development. None of the eleven companies has as yet announced that it will raise the grade of the ore being milled in consequence of the tax. The flurry that the 10 per cent flat tax caused among those interested in gold prospects and low-grade mines when it was first announced disappeared immediately when the tax was revised.

Canada's export trade at present comprises metals to the extent of more than 30 per cent, and the proportion is increasing steadily. This compares with 40 per cent of agricultural products; but whereas 85 per cent of the country's total farm products is consumed at home, about the same proportion of the metals is exported. In other words, Canada's metal-mining industry depends essentially upon export to world markets.

Quebec

In the Chibougamau district, 300 miles directly north of Montreal and 150 miles from the railway, two gold properties are being diamond drilled. At the Gilligan-Coffin property, under option to Noranda, a vein of payable grade and size has been outlined to a depth of 200 ft., and underground development is now warranted. Consolidated Chibougamau has also obtained good results by drilling. If Ventures, Ltd., constructs the light railway, surveys for which are completed, to its copper-gold property at Opemiska, 40 miles to the west, continued vigorous gold development at Chibougamau seems assured.

Dome Mines has taken over the Sigma gold prospect adjoining the Lamaque property of Teck-Hughes on the north. A prospect shaft to 100 ft. has shown high-grade ore for a good stoping width, and the vein has been outlined by drilling for a length of 1,000 ft.

Aldermac, with an enlarged shaft capable of handling 1,000 tons a day, is preparing to enlarge its 500-ton mill to that capacity. The high-grade pyrite concentrate is being shipped to ports on the Great Lakes and the copper concentrate to the Noranda smelter. Diamond drilling has recently discovered on the upper levels a new and apparently large deposit of copper ore, the grade of which is about double the average of the mine.

The Beattie mill is handling 1,000 tons daily. Developed ore stands at about 1,000,000 tons, and three times this amount in addition is indicated. A vigorous campaign of exploration is under way: The shaft is being sunk to a depth of 1,000 ft., some adjoining deposits are being drilled, and a general exploration is being conducted for further deposits. Concentrate is still being shipped to the smelter at Tacoma, but expectations are that a satisfactory method will be found for treating it locally.

Northwest Territories

The concentrator of the Eldorado silver-radium mine is to be increased to 75 tons' capacity, the additional equipment to be sent in during the coming summer. Mine development has been satisfactory recently, and additional high-grade radium ore has been found. The radium refinery at Port Hope, Ontario, is operating steadily. Extraction from the 58 tons of pitchblende treated during 1933 averaged 77.9 milligrams radium and 688.6 lb. uranium per ton.

Reports relative to the pitchblende discoveries at Hottah Lake, 40 miles south of Great Bear Lake, indicate that the deposits there are larger than those at Great Bear Lake. Samples of ore brought out of the Hottah Lake area have at least as high radium content as those representative of the Great Bear Lake deposit.

British Columbia

Arrangements are being made by Bralorne Mines to increase the capacity of its mill. Expectations are that it will be operating on a basis of 400 tons a day before the end of the summer.

Development operations on a larger scale are planned by Pioneer Gold Mines and include the sinking of No. 2 shaft from the 14th to the 20th, and possibly to the 26th, level, or to a depth of 3,125 ft.

In the Cariboo district the early erection of a small mill on the property of the Island Mountain Mines, a subsidiary of Newmont, is probable.

In the Boundary district the new 100-ton mill at the Dentonia mine is in operation, and shipments of concentrate are being made steadily to Trail. As a result of the success achieved in this instance a notable revival of interest in the rehabilitation of a number of old properties has developed in the district. Among those attracting new interest is the Dynamo Group, the exploration of which has been undertaken by a private corporation representing New York and New England capital.

Premier Gold Mining has acquired a 60 per cent interest in the Relief Arlington Mines, in the Salmo area. During the past year this old mine has responded very well to development and has yielded profitable results on a production of about 40 tons a day. Estimates indicate that at least two years' ore supply at the present rate of production exists at the property, but the possibilities of successful operating on a considerably larger scale are highly regarded, and plans to that end are being considered by the Premier company.

A 25-ton mill is about to be erected on the Kootenay Belle property, in the same area.

A report by independent engineers on conditions at the Meridian, in the Lardeau district, indicates that, although development has disclosed promising possibilities, it "is as yet too incomplete to warrant any assured or probable ore reserve estimate"; still "a relatively small amount of additional development may outline substantial tonnages to justify the provision of a mill."

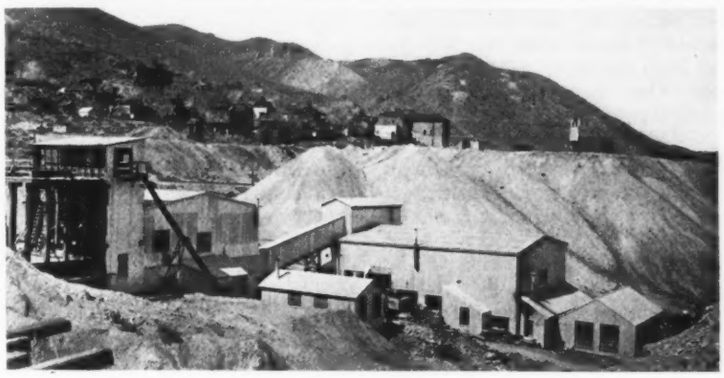
Ontario

Coniaurum is making a determined search for larger and more consistent orebodies, and this endeavor is beginning to meet with success on the 3,000-ft. level, where the largest veins of ore in the mine have been discovered recently.

Electrical power being now available at the Young-Davidson property in Matachewan, the 500-ton mill is expected to be in operation before the end of June. This will be the lowest-grade gold mine in Canada.

Two interesting "geological bets" are being pursued in the Porcupine area. Between Dome and McIntyre the drift-covered rock is being explored by drilling by Central Porcupine Mines. Just west of the producing area, in Ogden Township, McIntyre has acquired a large acreage covering rocks favorable to gold deposition and with certain structural features that are being investigated by drilling.

Activity Along the Comstock Lode Attracts Many to the Area



Two of the New Installations

Above—New headframe and surface plant erected by Dayton Consolidated Mines at its property near Silver City, Nev. Below—Mill of Arizona Comstock Corporation near Virginia City, Nev., which includes a new 200-ton unit

MINING activity on the Comstock Lode is reacting in a most encouraging manner to the higher prices of gold and newly mined silver. Production has increased from 75 tons to nearly 500 tons since a year ago. Three new mills have been built recently, making a total of five mills in operation in the district. The two custom mills at Silver City, controlled by the Donovan interests, are still in operation after many years of service. Old tailing dumps are receiving considerable attention, and several treatment plants are in course of construction. Numerous small-scale operations and much prospecting work are in progress all along Gold Hill Canyon. The leading producers in the district are the Arizona Comstock Corporation, operating the Savage, Chollar-Potosi, Hale & Norcross mines, at Virginia City; Dayton Consolidated Mines, at Silver City; and Consolidated Chollar Gould & Savage Mining Company, operating through the Overman shaft, at Gold Hill.

Apart from rehabilitation and development work in progress underground, Arizona Comstock is pushing the construction of a new 200-ton mill unit. This will raise the capacity of the mill to 300 tons per day. The new unit consists of a 425-ton coarse-ore bin which will bring up the storage capacity to 600 tons; a No. 37 Kennedy fine-ore crusher to reduce the ball-mill feed to ½ in.; an 8-ft. x 36-in. Hardinge ball mill operating in closed circuit with a 6x23 ft. 5-in. Dorr duplex classifier; and a Denver flotation unit.

The second largest enterprise in the district is that of Dayton Consolidated Mines. Reopening of the Dayton mine dates back about three years, when George Fuerman, of Virginia City, secured a lease and bond from the owners and unwatered the mine to the 220-ft. level. The interests operating the property at present entered negotiations in July, 1933. A thorough sampling campaign was undertaken, which disclosed a tonnage of ore sufficient to justify erection of a mill. Subsequent development involved retimbering of a three-compartment shaft to a depth of 270 ft., cutting of a skip pocket below the 220-ft. level, erection of a headframe and plant buildings, and general preparation of the 130- and 220-ft. levels for mining.

Metallurgical tests revealed that the Dayton ores were readily amenable to cyanide treatment. Arrangements were then made to acquire the plant at the Flowery property, in Six Mile Canyon, which was found to answer requirements as to capacity and flowsheet. Work on the mill was started on Oct. 15, 1933, and the plant was put in service March 3, 1934.

At the crushing plant the ore is crushed in two stages by a jaw crusher and a set of rolls. The mill proper contains a Marcy ball mill operating in closed circuit with a Dorr classifier; a tube mill operating in closed circuit with a Dorr classifier; conditioning, agitating, and thickening tanks; two Oliver filters; and Merrill precipitation equipment. Classifier overflow is elevated to the respective milling equipment by two Frenier pumps. The capacity of the mill is 150 tons.

Underground, the mine has gradually been placed in condition to provide the tonnage required by the mill. Additional air-compressor equipment is being installed, and the management will concentrate on development with the object of building up a satisfactory reserve of ore. Ore sent to the mill to date has been obtained from development faces and clean-up material. No waste, except that taken out in excavating the skip pocket, has been hoisted. Operations have been confined to the 130- and 220-ft. levels, but plans are maturing for unwatering the 300-ft. level. No plans for opening up the 500- and 700-ft. levels have so far been made. The company has not adopted any definite stoping method, but will use in each section of the mine that method which is most suitable. The various methods that will probably be employed comprise shrinkage, cut-and-fill, and square-setting.

Consolidated Chollar Gould & Savage Mining is remodeling its concentrating plant. The ball mill is being replaced with a larger one, and additional equipment is being installed to bring the plant up to a capacity in excess of 100 tons. The original 50-ton plant has operated efficiently, but proved to be too small to handle the daily ore output. Underground, extensive exploration is under way in various parts of the mine. Daily production exceeds 100 tons of ore obtained from development work containing values that will show a profit on the added mill capacity.

The outlook generally in the Comstock area is distinctly favorable, and indications are that further prospecting will be undertaken and that several other properties now in the course of development will reach a productive stage this year.

Gold-Mining Interests Veto Code And Ask for $100,000,000

THE gold-mining industry does not want a code. Five hundred delegates, representing eleven Western states and Alaska, assembled at Denver on May 18-19 under the auspices of the Gold Mining Association of America, and the three mining associations of Colorado, made this attitude toward a code plain. In fiery speeches, delegates denounced the idea of a code for an industry that is non-competitive, that has but one customer, the United States Government, and that embraces production in so many diverse climates and altitudes. However, when former Senator Tasker L. Oddie, of Nevada, president of the association, asked delegates to express themselves on the question of eliminating the code committee, the vote against such an action was unanimous. More moderate council also prevailed when the committee on resolutions met and adopted a resolution asking for more time to hold hearings and compile information on which a code, if one is eventually drawn, could be based.

A resolution was introduced on the floor of the convention by a Montana delegate advocating a complete reorganization of the United States Bureau of Mines for the good of the industry. He urged that a department of mines be substituted for the present Bureau of Mines, and asked that a "Western man, who knew his stuff" be placed at the head of the new department.

A declaration by Carl J. Trauerman of Butte, Mont., that "Montana doesn't want a code, doesn't feel it necessary, because gold mining is not a competitive industry" aroused enthusiastic applause. In contrast to Mr. Trauerman, who said that Montana, however, would go along with the rest of the convention if it decided it wanted a code, was the statement by W. R. Rops, of Helena, that "No Montana gold miners would sign a code."

One of the several resolutions that took up most of the second day's discussion was that drawn up by Harry S. Joseph, of Salt Lake City, advocating that $100,000,000 be loaned to the mining industry, to aid in bringing gold and other non-competitive metal-bearing deposits to profitable production. Harry Sears, of San Francisco, president of the Mining Association of California, made a speech in support of the resolution, showing that loans to the industry would enable this country to increase the total value of its gold production to more than $275,000,000 a year, expand payrolls by $78,000,000 annually, and create additional employment for 54,000 men. The loan of this amount of money, Mr. Sears said, would result in the expenditure of $40,000,000 for new machinery and equipment, $3,900,000 for supplies, $5,500,000 for building and construction materials, $4,300,000 for food and farm products, and $45,000,000 for labor. One thousand mines, large and small, would be affected in gold-mining districts.

In his opening speech, chairman Oddie urged that the gold industry set up a solid front against any effort to place a tax on gold. "We don't want any strings on the gold industry," he said.

Other resolutions included one advocating "that all custom smelters and custom mills throughout the West modify the practice of deducting from the real price of gold, as fixed by the government in their final settlement for bullion or ores, so that only reasonable smelting or milling charges shall obtain." This resolution was aimed, it is said, at the 10 per cent deduction for smelter losses. Congratulations were embodied in another resolution to Western Senators and Representatives for their work in modifying the "excessively stringent regulations of the National Securities Act so detrimental to the mining industry, and that they be requested to endeavor to obtain further and additional modifications."

Labor and Anaconda Officials In Deadlock at Butte

In April the mine and craft unions of Butte, Anaconda and Great Falls notified the Anaconda Copper Mining Company of certain demands. These included, for the miners, a 30-hour week and minimum underground wages of $1.20 per hour, establishment of a closed shop and the check-off system, and abolition of the contract mining system and one-man drilling machines. The crafts demanded a minimum wage of approximately $1.45 per hour. The present underground wage scale is $4.25 for eight hours.

Soon thereafter a strike vote was taken by the Butte Miners Union, which has a membership of about 5,000. More than 1,500 members voted, and the outcome was about 11 to 1 to strike on May 8 if the demands were not granted. On May 8 the strike started, and, for the first time in any labor dispute in Butte, the engineers and pump men were called off their jobs, leaving no protection against mine flooding or other contingencies. However, these contingencies have been taken care of by the company up to the present time. At the Great Falls plant the men did not strike.

Anaconda closed its smelter and put an embargo on custom ores. This is working a hardship on some of the producers of siliceous gold and silver ores, on which Anaconda charged a low rate. However, the East Helena smelter of American Smelting & Refining has removed its silica penalty, for the time being, and is receiving some of the custom ores that formerly were shipped to Anaconda. Even with this accommodation, some of the shippers of close-to-marginal ores have had to suspend operations.

At the annual meeting of Anaconda Copper on May 16, J. R. Hobbins, vice-president of the company, said, in commenting on the strike: "While your officers are unable to estimate over what period of time this strike may be prolonged, we nevertheless desire to advise you that we have ample stocks of copper with which to carry on our fabricating and manufacturing operations for a great many months, and that if and when it becomes necessary, your company can and will secure its copper requirements from other properties of the company in this country."

Shortly after the strike started R. C. Jacobson, of Chicago, a representative of the National Labor Board, came to Butte in the rôle of arbiter. He has been conferring with representatives of the strikers and officials of the company.

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Aluminum Plant Proposed In Tennessee Valley

Construction of an aluminum manufacturing development in the Tennessee Valley is being considered by the Public Works Administration, according to Washington advices. Secretary Ickes is reported to be somewhat interested, but on guard against supporting any promotional scheme. He will rely on governmental agents to advise him regarding bauxite deposits.

Application for a $20,000,000 loan has been made to PWA by the Standard Aluminum & Alloy Company, Chicago. The company is planning to build a plant at Decatur, Ala., using bauxite from deposits in Arkansas said to be controlled by a financial group with headquarters in New York. Sponsors of the plan state that 12,000 men would be employed in constructing the properties and about 9,000 tentatively would be employed in operation.

A process for recovering aluminum, controlled by R. J. Gaudy, consulting engineer, Chicago, is to be used, and the claim is made that aluminum could be marketed at one-half the present cost.

Power generated by TVA would be employed, and those backing the project believe that a preferential contract could be obtained for 200,000 hp. of energy a year for a period of twenty years at low rates, possibly less than 2 mills per kilowatt-hour. Present plans call for a daily output of 200 tons of aluminum.

Personal Notes·Comment·Criticism

Guy H. Ruggles, of Inspiration, is in Cananea on professional business.

Charles A. Ordway is in Mexico City for a stay of from three to four weeks.

J. F. Mitchell-Roberts, metallurgical engineer, of New York City, is in California.

F. J. De Wilde, of Chicago, is in Tucson, Ariz., on consulting work.

Charles Janin, consulting engineer, San Francisco, is in Nicaragua on professional work.

George A. Shaw has resigned as mine manager for the Nicola Mines & Metals at Stump Lake, B. C.

M. W. von Bernewitz is returning to the United States after an extensive trip to Australia and New Zealand.

C. E. Rhodes has joined the staff of the Cia. Minera Chontalpan y Anexas at Taxco, State of Guerrero, Mexico.

Andrew Walz has reopened the Malartic Gold property, in Quebec, which is controlled by Ventures, Ltd.

Amor F. Keene arrived in New York on May 31, after having visited Tanganyika Territory.

W. D. O'Brien, engineer for the Crocker banking group of San Francisco, has been examining gold properties in Nevada.

H. E. Silver is making an extended examination of the Goldside property, in the Bridge River district, British Columbia.

Harold J. Wasson, Samuel Brenner, and **Edward L. Bradley** have been elected directors of Consolidated Coppermines Corporation.

W. D. B. Motter, Jr., mining engineer and assistant to the vice-president of Chile Exploration, recently made a trip to the Pacific Coast.

William J. O'Connor has been elected chairman of the Utah section of A.I. M.E., and **E. A. Hamilton** has been elected vice-chairman.

George Scholley, of the engineering staff of Balatoc Gold Mining Company, of Baguio, Philippine Islands, has been visiting in Arizona.

E. P. Sawyer is in charge of the 50-ton mill of Diana Mines, formerly Gem Lake Mines, Manitoba, which he has reconditioned and put in operation.

Mark Bradshaw, president of Bradshaw, Inc., treating tailing from the old Goldfield Consolidated cyanide mill, has returned to Reno, Nev., from New York.

C. B. Dawson has reopened the Poundmaker (formerly Selkirk) property near the San Antonio, in Manitoba, which formerly was developed to 525 ft.

Thayer Lindsley has been appointed president of Tonopah Mining Company, of Nevada, following the acquisition of control by a Canadian group of which he is a member.

C. S. Gibson has been appointed manager of Casey Summit mine, in the District of Patricia, following **H. F. Faney,** who has left to take charge of a prospect in the same area.

Duncan Smith has returned to Vancouver from an extensive tour of the Bridge River district, in British Columbia, visiting, among others, the Bralorne, Minto and Pioneer mines.

C. O. Fricker has resigned as mill superintendent with Granby Consolidated Mining, Smelting & Power Company, to take a position with the Rhokana Corporation in Northern Rhodesia.

Frank W. Collins, well known to the mining and metallurgical fraternity of the Pacific Coast, announces that he has become associated with the Pan-American Engineering Corporation, in San Francisco, Calif.

E. A. Julian, directing engineer for Goldfield Consolidated Mines, has been at Aurora, Nev., to start systematic prospecting in an unexplored part of the Aurora Consolidated property, owned by Goldfield Consolidated.

John A. Agnew has been awarded the gold medal of the Institution of Mining and Metallurgy in recognition of his services in the development of the mineral resources of the British Empire.

Andrew Fairweather, superintendent of the Broken Hill South, and **D. H. Woodword,** superintendent of Broken Hill Associated Smelters, Australia, arrived in Vancouver on May 18 en route to visit the leading mines in Canada.

J. A. Reid, consulting mining engineer to the Connell Mining & Exploration Company, of Toronto, returned from Panama on May 19, and expects to spend the rest of the year in Canada, probably in northern Ontario.

Mathew Van Siclen, formerly of the United States Bureau of Mines and now consulting mining engineer for the Turkish Government, is on a trip through east Turkey, to continue to Mount Ararat, exploring gold deposits.

George C. Branner, of Arkansas, was recently elected president of the Association of American State Geologists. **Arthur Bevan,** of Virginia, is secretary, and the third member of the executive committee, to be elected this year, is **Raymond C. Moore,** of Kansas.

V. A. Brussolo, formerly assistant mine superintendent at the Nacozari unit of Phelps Dodge Corporation and until recently with the Cardinal Gold Mining Company at Bishop Creek, California, has joined the staff of Cia. de Real del Monte y Pachuca, at Pachuca.

H. H. McKinstry has gone to South Africa on professional business, but will return soon to Australia, where he is associated in an advisory capacity with Western Mining Corporation and Gold Mines of Australia. He is a member of the board of directors of the recently organized Bendigo Mines, Ltd.

K. W. Fritzsche, field engineer for Alderson & MacKay, Montreal, is opening the Dik Dik gold prospect, 10 miles north of Kinghorn station on the Canadian National Railways, east of Port Arthur, Ontario.

Frank L. Hess, engineer in charge of the rare metals division, United States Bureau of Mines, addressed the New York Mineralogical Club on May 16 at a meeting held in the American Museum of Natural History. Mr. Hess discussed uranium and vanadium deposits in the Colorado plateau.

H. G. Snyder, president of Greeley Gold & Silver Mines and a well-known Utah mine operator, has been in the Como district, south of the Comstock, where he has started work on a substantial scale for his company. He was accompanied by **F. O. McFall,** of Salt Lake City.

G. W. Gray, president of the Institution of Mining and Metallurgy, said at the annual dinner that this year had marked a very definite revival in the fortunes of the mining and metallurgical professions. It was specifically due to the stimulus given to gold mining by the rise in the price of gold.

G. C. Riley is making an extended trip to Portugal, Spain, Italy, Germany, France, and England. While abroad Mr. Riley intends to make a special study of most recent developments in underground mining methods, as well as some of the bigger contracting projects. He expects to be back in his office, at 1075 Beaver Hill Hall, Montreal, this fall.

Tasker L. Oddie, president of the Gold Mining Association of America and former Nevada Governor and Senator, has returned to Reno after presiding at the Association convention in Denver. He delivered the commencement address at the Golden School of Mines and was invested with the honorary degree of Doctor of Engineering.

John B. Kasey, formerly superintendent of properties for Amarillo Gold Mining Company, Tres Piedras, N. M., is now with the Wellton Mining & Milling Company, Wellton, Ariz., serving as mill superintendent. The company has a 25-ton cyanide unit 6 miles south of Wellton, and is treating ore averaging about $14 with gold at the current price.

Clyde E. Williams has been appointed director, and **Dr. H. W. Gillett** has been made chief technical adviser, of the Battelle Memorial Institute, at Columbus, Ohio. Both Dr. Gillett and Mr. Williams have been associated with the Institute since 1929, Dr. Gillett as director, sharing the administrative duties of the directorship with Mr. Williams as associate director, and at the same time serving as metallurgical supervisor of the Institute.

Sir Philip Cunliffe-Lister, Secretary of State for the Colonies, of Great

Britain, said after returning from a tour of East Africa that the best proof of the actual and potential value of the Kakamega gold field, in Kenya, was that some of the best-known mining concerns in the world thought it worth while to spend money prospecting there.

L. T. Burwash has taken a crew of men to open gold prospects found last year on the Yellowknife River, near Fort Rae, which is north of Great Slave Lake. Major Burwash has taken an active interest in the mineral developments of this far northern region of Canada, which he supervised in the rôle of a government official until his retirement last year.

J. G. MacGregor, in conjunction with **J. H. Banks,** is examining the Condor Consolidated gold property, in North Carolina. Dr. Banks and Mr. MacGregor have been associated for the past year in the development of MacMillan Gold Mines, in the Sudbury region, Ontario, at which property the 100-ton mill is expected to turn over in July, a year after the old mine workings were unwatered.

E. Wittenau, formerly mill superintendent for the Phelps Dodge Corporation at Bisbee, Ariz., is the new mill superintendent of the recently reopened New Cornelia branch of the corporation at Ajo. The chief chemist, **T. E. Steele,** held a similar post at Bisbee; **R. M. McDougal,** master mechanic, and **J. R. Bowie,** in charge of warehouse, had those positions at Morenci; and **Ben H. Cody,** metallurgist, was tank-house superintendent for the New Cornelia company.

Claudius T. Murchison, nominated by President Roosevelt for the directorship of the United States Bureau of Foreign and Domestic Commerce, was born at Hickory, N. C., April 17, 1889. He received the degree of A.B. from Wake Forest College in 1911, and Ph.D. from Columbia University in 1919. Mr. Murchison has lectured in economics at many universities and colleges. He is a member of the American Economic Association, the American Statistical Association, the Academy of Political and Social Science, and the American Association of University Professors.

Obituary

Clyde B. Peterson, mining engineer, was killed recently by a premature blast in a tunnel of the Independence mine, 60 miles southwest of Big Timber, Mont.

John Cole, mining pioner of Ontario, and well known throughout Canada in gold and silver camps, died recently in Red Lake, in northern Ontario; aged 70.

W. H. Stafford, director of Anglo-Huronian, Ltd., died at his home in Almonte, Ontario, on May 12. He was associated with the late J. Mackintosh Bell in the development of the Keeley and other mines in Ontario.

Harry M. Spoor died on May 4 in Melilla, Spanish Morocco. For the past several years Mr. Spoor had been the mine manager of the Compania Español de Minas de Rif and had just successfully completed installing modern machinery which brought the mine up to a large production at a very low cost. Mr. Spoor was 55 years old and had previously been employed by the Bethlehem Chile Iron Mines Company and the Chile Copper Company.

A Lode Gold Mining Venture In the Lupa Field

The Editor:

Your February issue carries a very excellent article on the Lupa gold field, in the British Mandated Territory of Tanganyika, East Africa, although practically no information is given regarding the important development work which has been done on the quartz lodes in this area.

A company was formed in 1933 known as East African Goldfields, Ltd., for the purpose of acquiring and operating lode mines in the Lupa field. The directors are as follows: Harry St. Leger Grenfell (chairman); Lt.-Col. Lord Francis Scott (member of Legislative Council of the Colony and Protectorate of Kenya); Sir Albert E. Kitson (director of Tarquah & Abosso Mines, Ltd.); James R. Leslie; John A. Finnigan. The London Committee consists of Sir Godfrey Butler Hunter Fell (chairman of Indian Copper Corporation, Ltd.); Felix Heim (member of London Committee of Rand Mines, Ltd., and Crown Mines, Ltd.); Charles W. Hobley (former Commissioner of Mines, Kenya Colony).

The company has acquired, or has under option, most of the important auriferous quartz outcrops in the field, and has surrounded these showings by a 92 square mile concession obtained from the Tanganyika Government, protecting all immediate extensions of the veins.

Exploration work to date has been confined to four major vein systems, or shear zones, in a country rock which has been classed as Pre-Cambrian. These shear zones contain prominent outcrops and veins aggregating over 50,000 ft. along the strike.

Development work consists of 967 deep surface cross trenches at uniformly spaced intervals, 13 shafts averaging 65 ft. in depth—three being 100 ft. deep; one 450 ft. adit, and many short drifts and surface pits. This has served for prospecting and sampling a total of 34,260 ft. of vein, disclosing an aggregate of 7,442 ft. of commercial oreshoots of an average grade of 0.375 oz. of gold per ton over an average width of 6.1 ft. This is equivalent to about 346,000 tons of ore for each hundred feet extension in depth.

A typical quartz outcrop on the Luika vein in the Lupa field

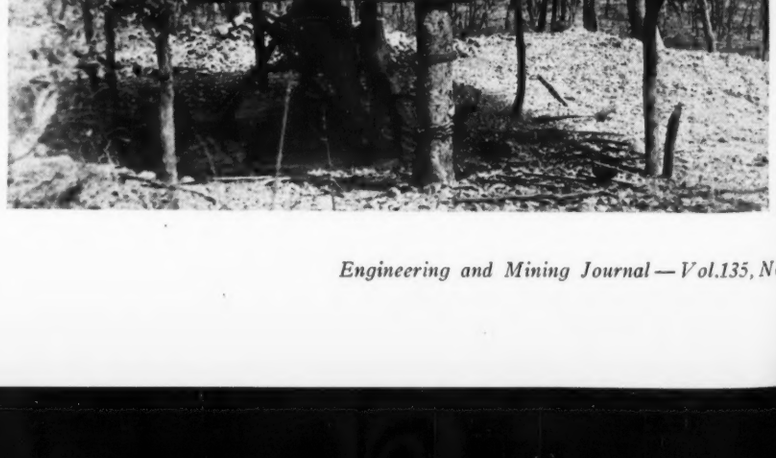
The field is situated at about 3,500 ft. elevation. Power can be developed by either water, wood fuel, or by utilizing coal found some 60 miles to the south. It is accessible by the Central Railway from the port of Dar es Salaam, inland to Dodoma, a distance of 284 miles, and thence by road another 493 miles, available for heavy trucking eight to nine months of the year. A road from Tabora, on the railroad, is now being improved by the government, and will shorten the haul to 287 miles.

All planes of the Imperial Airways on the regular Cape-to-Cairo route stop at M'Beya, 87 miles from the camp, making London in eight days or Johannesburg in two days.

The immediate development program involves the sinking of three operating shafts on what are known as the Saza and the Luika vein systems, together with diamond drilling of this area.

LeRoy M. Gross

A prospect shaft in the East African Gold Field concession



BOOK REVIEWS

A Geologist Turns Historian

ROMANTIC COPPER. *By Ira B. Joralemon. D. Appleton-Century Company, Inc., New York, Pp. 294. Price $3.*

If fiction has been mixed with fact in the pages of "Romantic Copper," few who read the book will care. The stories of discovery and exploitation, flavored with episodes of adventure, fickle fortune, and rascality, are highly entertaining. The author declares he has used in part the current tales about this and that affair told by people who were living in the region at the time and who possibly knew the truth as well as those who wrote the official version. No "de-bunking" spoils the pages, however, and no bootlicking. The author's speech is often blunt. He minces no words in dealing with sundry individuals.

Romance, if ever, surely twines about the mining lore of ancient times, in which fact is indistinguishable from legend. The opening tale is of the rediscovery, by Gunther in 1912, of the Skouriotissa mine, in Cyprus, worked by Romans, Greeks, and Phoenicians back to the dawn of history, whereby copper got its name. Then follows the colorful story of Rio Tinto, fascinating from any viewpoint and stretching over 3,000 years. Next, in a sudden change to a backwoods setting, with atmosphere supplied by Chippewas and Cousin Jacks, the discoveries of the Michigan Copper Country are portrayed. Stories of Butte and Bisbee follow, that of the former replete with violence and villainy. Bill Greene, of Cananea fame, is then made to do his bit, which he does in an amazing way, and after he has run his course and prosaic efficient management has descended over the great Consolidated, the story of Ajo is told, with the principals painted most unflatteringly up to the point where Col. "Jack" Greenway takes hold.

The seven stories are seven jewels. In the remaining 80 pages the author mingles philosophy with romance, and fancifully tries to show how Fate has regulated the supply of copper, broadly speaking, according to the needs of mankind (let the Code Authority take notice!). To sum up the idea—new mines have been found in time to avert a copper famine and, on the other hand, their respective discoveries have been delayed long enough to prevent an overproduction that would have bankrupted all producers. If Mr. Joralemon's theory be correct, the logical deduction is cheering: perhaps the not-too-distant future will indeed bring with it a demand for copper that will confound the pessimists, devour the surplus, and forever dispel for the American producer the bogey that has been hovering of late over Katanga and Northern Rhodesia.

A. H. HUBBELL.

Trigonometric vs. Graphic Solutions

DIP AND STRIKE PROBLEMS MATHEMATICALLY SURVEYED. *By Kenneth W. Earle. Thomas Murby & Company, London. Pp. 126. Figures 122. 1934.*

This book is devoted principally to a trigonometrical solution of the most common types of problems encountered in geologic structures. Among the problems discussed are: finding true dip from apparent dips; finding the line of intersection and the angle between two planes; dip and strike of underground seams, from boreholes; lengths of adits to reach given seams; and fault problems. An appendix discussing mechanical devices for solving dip and strike problems has been added. A very useful glossary of structural terms and a two-page bibliography are also included.

Almost the entire space is devoted to deriving complete trigonometric solutions for these problems. Graphical solutions, though in some cases discussed briefly, are in general given only minor attention. The reason for this the author explains in his preface:

"The chief objections to the use of geometrical constructions in solving geological problems are that, on the one hand, a different construction and a different figure are necessary for every problem, and on the other hand the degree of accuracy obtainable by such methods is at best only approximate (an error in angles of only 3 deg., though small, will lead to increasing linear errors over long distances)."

Anyone who has ever undertaken to derive trigonometric solutions to problems of this sort must be aware of the complexities of even the simplest of three-dimensional problems. The author of this book has defined his objective to be the presenting of such solutions, and this he has accomplished quite admirably. The usefulness of the book, however, still depends upon the question of the relative merits of graphical versus trigonometric solutions. There is not one of the problems discussed here that cannot be solved quite simply with pencil, compasses, scale, and protractor by one of several simple graphical methods with an accuracy of a per cent or so. By contrast, the complicated trigonometric formulas appear rather formidable, especially if one has to remember them in the field or else re-derive them as occasion requires.

In most geological work the apparent greater accuracy afforded by the trigonometric formulas appears to the reviewer to be rather an illusion in that the observational data themselves are rarely of an accuracy greater than the results given by a graphical solution. It may be that in mining work where distances are small and more precise observations are made this greater degree of precision is required, in which case this book will be found decidedly useful.

M. KING HUBBERT.

METAL STATISTICS 1934. *American Metal Market, 111 John St., New York. Pp. 544. Price $2.*

The 27th annual edition contains the same general statistical information on ferrous and non-ferrous metals as has been supplied in previous years. Owing to the widespread interest in silver, new data covering production, consumption, and prices have been added.

RIEMEN UND SEILTREIBE. *By E. vom Ende. Sammlung Göschen Vol. 1,075. Walter de Gruyter & Company, Berlin. Pp. 110, illus. Price, 1.62 Rm.*

A book intended for the engineering student as well as for the practicing engineer, treating the theoretical and practical aspects of belt and rope drives, with examples and tables.

MITTEILUNGEN AUS DEN FORSCHUNGSANSTALTEN VON GUTEHOFFNUNGSHÜTTE, OBERHAUSEN. *Düsseldorf, Germany. Vol. II, No. 8.*

Included in this report from the Gutehoffnungshütte research institute is a survey of losses in steam hoisting.

TRAITEMENT DES MINERAIS AURIFÈRES D'ORIGINE FILONIENNE AUX MINES D'OR DE KILO-MOTO. *By R. Authoine. Published in Brussels, Belgium, by Hayez, printer for the Royal Belgian Académie. Pp. 163.*

A complete report on the operations of the Kilo-Moto, the important gold mine in Belgian Congo. It is prepared by the chief engineer.

WEST AFRICAN GOLD MINING HANDBOOK 1934. *Compiled and published by Walter E. Skinner, 15, Dowgate Hill, London, E.C.4. Pp. 50. Price, 2.6d. net., or 3s. post-free abroad.*

This reference work contains a brief history of the West African gold fields and a record of gold production since 1927. Following the style of the Mining Yearbook, from which it is mainly compiled, there is a brief record of information about each of the companies in the West African gold mining area, together with an alphabetical list of directors of companies described.

INDUSTRIAL PROGRESS

A New Torsion Balance for Fast Work

Cost of Making Geophysical Surveys Lessened With Its Use

After ups and downs, torsion-balance work is experiencing a revival. Two reasons account for this: successful surveys in different areas due to improved field technique have given an impetus to gravitational work, and old equipment could be put to work again at a comparatively small cost. About 70 torsion balances are in the field again, and no doubt the number will increase further. Instruments in service are largely limited to the original Eoetvoes type and the automatic Askania balance. So far as known, none of the English torsion balances, as for instance the large Oertling balance, the Oertling Gradiometer, or the Hungarian Rybar automatic torsion balance, are now in use in the United States.

Furthermore, a new torsion balance has just been introduced which, due to its faster and more economical operation, will cut field expense to the point where the small operator and consulting engineer may find it worth while to consider torsion balance work in the future. Whereas station cost used to run about $12 to $15, it will now be possible to cut it to $7.50 per station. The new balance is made by Askania.

The instrument is of the photographic type and rests on a light tripod. Its beam presents the most radical departure from earlier designs. Whereas the previous Askania balances had a horizontal beam with one weight of the beam hanging at a lower level on a thin brass wire (large type), or a rigid Z-shaped beam, as contained in small Askania balances, the new instrument has a straight and inclined beam (two for each instrument reversed through 180 deg.), with a special suspension system. The construction of this beam and of the chamber in which it swings, as well as the slightly heavier wire of tungsten material, have reduced the period of observation from 40 min., with the well-established Askania Z-balance, to 20 min., with the new instrument. The sensitivity of the new balance has suffered a slight loss, it is true, but comparative field tests in Texas and Louisiana with the inclined beam-balance and the Askania Z-bar instrument have furnished excellent results and have proved the value of the new instrument.

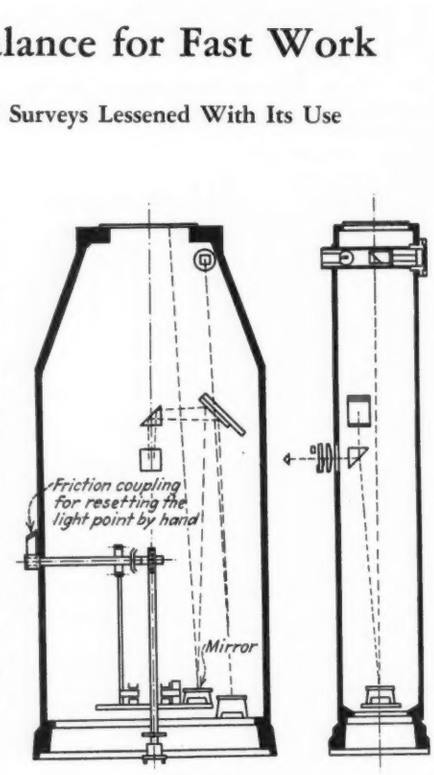


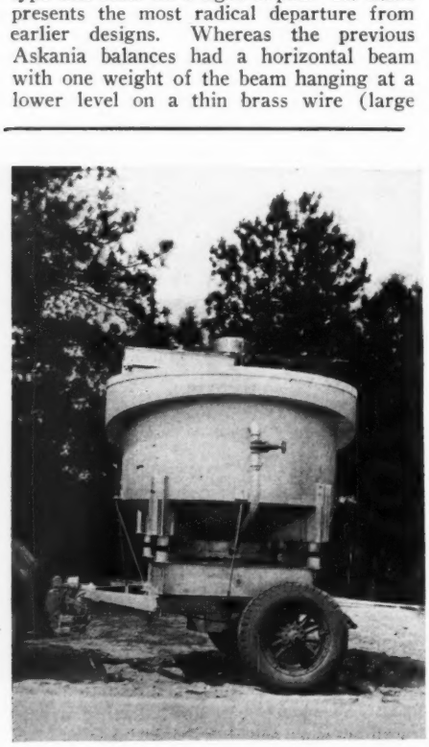
Diagram of optical system of new torsion balance.

The beam system with its two protective chambers can easily be taken off, if desired, a distinct advantage from the standpoint of any field operator. The whole practical system with its mirrors and prisms is shown in the sketch, all mirrors being easily accessible from the outside. The plate clock controlling the movement of the photographic plate on top of the instrument has been eliminated. Instead, the displacement of the various light dots of the fixed, temperature and balance beam-mirrors is obtained by movable mirrors coupled with the rotation of the torsion balance. The instrument is light (55 lb. for semi-automatic operation or 85 lb. for completely automatic operation) of small size (about 4 ft. with a center of gravity at 70 cm.).

The American Askania Corporation, of Houston and Chicago, has brought out a bulletin descriptive of this new development.

New Light Diesel

A diesel engine of the opposed-piston type, in which the weight has been reduced to 20 lb. per horsepower, has been introduced by Fairbanks, Morse & Company, Chicago. Aluminum has been used for parts not subject to stress. Space requirements for an engine of a given horsepower have also been considerably lessened. Combustion efficiency has been increased by im-



Test Classifier on Wheels

One of the accompanying photographs shows a full-sized hydraulic classifier mounted on a trailer for hauling from Pennsylvania to Florida for a demonstration. This was done by the Hydrotator Company, of Cleveland, Ohio, and, as a result, the company's new Hdyrotator classifier is now being tried out by various phosphate companies for classifying fine phosphate rock, According to the company, the unit takes the washer water and fine solids, overflows the water, clay, and fine solids through 60, 100, or 150 mesh, as desired, and underflows a clean, deslimed sand product, ready for flotation treatment. The company plans to conduct demonstrations with this classifier in the Lake Superior Iron Country and in any other territory where classification is practical. The photograph on the right shows the hydraulic classifier set up.

proving the scavenging and using a greater virtual stroke-bore ratio. The number of parts has been reduced, thus simplifying combustion. Elimination of cylinder heads, accomplished by confining the combustion space between the two pistons, not only improves the combustion, but also allows better cooling facilities at this point, and removes the need for gaskets.

Engines of the opposed-piston type are inherently balanced, because the reaction forces of the two pistons in the cylinder oppose and tend to counteract each other. This contributes to higher rotative and piston speeds, with resultant reduction in weight.

Control features are unusual. The three functions of regulating injection timing, pressure, and quantity are centered for the first time in a single lever.

The new engine is made in five cylinder sizes, ranging from 5x6 in. to 12x15 in., and in six-, seven-, and eight-cylinder combinations. Power capacity ranges from 50 to 300 hp. per cylinder.

A Submersible Motor Pump

Designed to operate unattended for long periods, a submersible turbine pump, developed by the Submersible Motorpump Company, Ltd., of Huntington Park, Calif., is being advocated for mining service. Pumps and drive are entirely submersible, the motor consisting of a three-phase induction unit, and the pump being a centrifugal turbine type having bowls and runners of cast iron, with bronze water-lubricated bearings and a stainless steel shaft. The shaft is extended to permit an additional bowl without dismantling the unit.

Hose Joint Flexible

A new hose joint which eliminates all contact between metal and fluid has been patented by the B. F. Goodrich Rubber Company. It is said to permit greater flexibility than any other type of coupling or joint and to afford a perfect seal in all service up to 125 lb. working pressure.

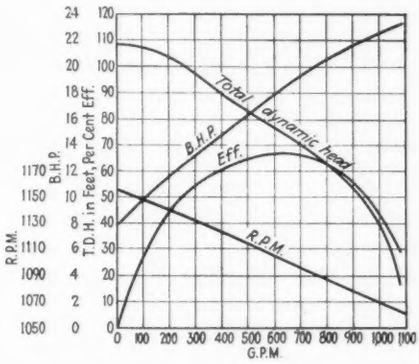
The "Flexseal" joint, as it is known, is designed particularly as a substitute for nipples and flanges, and is recommended particularly for larger diameters of suction or discharge hose handling abrasive materials, and for hose handling. Its success is dependent on the unique end which is built into the hose. This consists of an enlargement, or bead, reinforced with numerous plies of fabric surrounding a rigid steel ring of angular cross-section. The joint is assembled with the aid of split flanges and standard bolts.

Threadless Bronze Fitting Uses Silver Alloy

A new threadless bronze pipe fitting has been perfected, it is said, through the collaboration of the Air Reduction Sales Company, Walworth Company, and Handy & Harman. It will be made by Walworth. Each opening of one of these fittings is provided with a ring of brazing alloy, known as Sil-Fos. This alloy contains a small percentage of silver. To install the fitting, one merely slips the pipe into it and then applies the oxy-acetylene flame until the Sil-Fos flows out between the fitting and the pipe in both directions from the ring, thereby sealing the joint. The joint thus finished is said to be stronger than the pipe itself.

Pump Impeller and Lining of Rubber Composition

An improvement in the Hydroseal sand pump which, it is said, will reduce maintenance costs in the pumping of even the most highly abrasive materials has been announced by the Allen-Sherman-Hoff Company, Philadelphia. The company has developed a new rubber composition called Maximix, which is molded to form the pump impeller. Casing and side plates are likewise protected by corresponding parts molded of this material. Claim is made that these parts will outlast the best alloy steels four to one when handling pulps, and that they weigh only one-tenth as much as similar metal parts. All Maximix parts are replaceable in the field and no vulcanizing will be required. Mills can thus keep a small stock of them and replace them quickly when required. This pump makes use of the principle of sealing the annular clearances between impeller and pump side-plates with water. This, it is held, will introduce a saving of one-third in power costs, due to the fact that efficiences of over 50 per cent are developed and maintained without adjustment or change of speed.



Clear-water characteristics for standard horizontal Hydroseal pump equipped with runner and parts of special rubber composition.

Industrial Notes

The Dorr Company, Inc. and Oliver United Filters, Inc. announce that after an affiliation for three years the company has agreed to dissolve the Dorr-Oliver Corporation, and that hereafter the two organizations will operate independently of each other. Oliver-United will undertake the further adaptation and marketing of the Dorrco filter in the United States and in certain other countries; and Oliver-United products, including filters, will be handled in European territory by the foreign representatives of The Dorr Company. Both Dorr and Oliver-United will continue to be represented in South Africa by E. L. Bateman, Pty. Ltd., Johannesburg; in Australia, by Crossle & Duff, Pty. Ltd.; and in Japan by Andrews & George Company, Inc., Tokyo, acting independently of each company. The separation of the two companies is entirely friendly.

Schlumberger Electrical Prospecting Methods organization makes the following announcement: "Some years ago various electrical surveys were performed on the property of the Kingdon Mines, Ont. The methods employed and the results obtained attracted the attention of the mining fraternity particularly, owing to the fact that they were discussed in detail in a lawsuit, which took place between the Kingdon Mines and the Hydroelectric Power Commission of Ontario. Among the methods referred to was the so-caled spontaneous 'polarization' and 'resistivity' systems, which were used by two well-known Canadian scientists. Because of the fact that no specific mention was made by them in the proceedings that this particular work was of a scientific nature, the incorrect impression may have been conveyed that such processes were in public use. It seems, therefore, proper to draw the attention of the public to the fact that they are covered in Canada by Patents Nos. 205,676, 214,063, and 220,693, and that they cannot be utilized for commercial purposes unless under a license arrangement that has been duly secured from the owners to this effect."

John W. O'Leary has been re-elected president of the Machinery & Allied Products Institute. The executive committee also continues largely as constituted in the past year.

BULLETINS

Electric-powered Hydraulic Dredge. American Manganese Steel Company, Chicago Heights, Ill. Eight-inch pump size for commercial sand production. Pp. 8.

Belt Conveyor Idlers. C. O. Bartlett & Snow Co., Cleveland, Ohio. Bulletin 72. Pp. 12.

Dust Hazards. Northern Blower Co., Cleveland, Ohio. Series of monthly folders.

Colorado-type Hoisting Signal System. Jeffrey Manufacturing Co., Columbus, Ohio. Folder. Pp. 2.

Ore-Dressing Notes. American Cyanamid Co., 30 Rockefeller Plaza, New York. No. 1, April, 1934.

Boiler Feed Pumps. Mather & Platt, Ltd., Manchester, England. No. P 812, Pp. 32.

Tisco Rivetless Buckets and Lips. Taylor-Wharton Iron & Steel Co., High Bridge, N. J. Pp. 4.

Diesel Electric Locomotives. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Circular 1994. Pp. 80.

Use and Care of Wire Rope. A. Leschen & Sons Rope Co., St. Louis, Mo. Bulletin of practical information. Pp. 40.

Gyrex Screens. Robins Conveying Belt Co., New York. Bulletin No. 90. Pp. 24.

Denver Sub-A Flotation Cells. Denver Equipment Co., Denver, Colo. Circular. Pp. 4.

Short Cuts to Power Transmission. Flexible Steel Lacing Co., Chicago, Ill. A handbook for belt users. Pp. 72.

Raymond Kiln Mill. Raymond Bros. Impact Pulverizer Co., Chicago. Pp. 8.

Hi-Cast Refractory Concrete. Denver Fire Clay Co., Denver, Colo. Bulletin No. 147. Pp. 8.

Squirrel-Cage Induction Motors. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Leaflet 2173. Pp. 4.

Spiro Concentrators for Gold Extraction. Mine Equipment & Engineering Co., 546 North Western Ave., Los Angeles, Calif.

Twist Drills. Edgar Allen & Co., Ltd., Sheffield, England. Handbook of information, by B. H. Chambers. Pp. 143. Price 3s. 6d.

Diamond Drills, E. J. Longyear Co., Minneapolis, Minn. Bulletin 37, The Longyear Prospector. Pp. 8.

Convertible Excavator-Crane. Bucyrus-Erie Co., Erie, Pa. Model 10-B, ⅜ cu.yd. Pp. 10.

Mine Car Bearings. New Departure Manufacturing Co., Bristol, Conn. Pp. 8. Also a bulletin on conveyor-roll bearings.

Mechanical Power Transmission. A study of individual motor drives and modern group drives prepared by Robert Drake for 35 manufacturers of leather belting and mechanical power transmission equipment, covering practical plant application, operation, and maintenance of all kinds of motor drives, including multiple V-belts, belting, chains, and gears. Obtainable from American Leather Belting Association, 41 Park Row, New York. Pp. 224. Price 25c. per copy.

Market Summary—Quotations

THE VOLUME of new business booked in major non-ferrous metals during May was smaller than in the preceding month. This decline in buying interest was attributed to what developed to be a slightly overbought condition of fabricators and some uncertainty over the outlook for general industrial activity for the summer period. The weakness in the security market and the labor troubles certainly did not help matters. The price structure eased moderately, our index for the month of May being 68.87, against 69.42 a month previous.

Copper producers and consumers spent most of the month in interpreting the marketing provisions of the Code. Effective May 2, all quotations for "non-Blue Eagle" copper were withdrawn in the domestic market, pending "further consideration and investigation" by the Copper Code Authority. Up to the end of May no final decision had been reached on this question. The recognized domestic price of copper throughout the month was 8.50c., Valley, or 8.275c. f.o.b. refinery. Export business continued in fair volume, but the price eased off on a rather bearish interpretation by foreign consumers of the effect of the Code on world prices. United States exports of refined copper during the first four months of 1934 amounted to 73,584 tons, against 36,689 tons in the same period last year.

Approval of the lead code had no influence on the market for the metal. The price fell from 4.25c. to 4c., New York, during the month, producers lowering the market to induce buying and retard the movement of scrap. The reduction in price did bring out a substantial buying movement.

Prime Western zinc sold toward the close at 4.30c., St. Louis, against 4.40c. a month previous. Output of concentrate in the Tri-State district has been increasing, unsettling the zinc market.

Silver moved higher, contrasted with a month ago, though speculative interest lessened considerably. Buying of silver, said to have originated in sources close to the Government, was a supporting factor. Platinum was reduced to $36 per ounce, with producers evidently eager to expand the demand for metals in this group for industrial purposes.

E.&M.J. Weighted Index Of Metal Prices

100 Is Composite of Non-Ferrous Prices for 1922-23-24

May, 1934	68.87
April, 1934	69.42
March, 1934	67.83
May, 1933	57.35
May, 1932	46.20
May, 1931	59.81
May, 1930	83.41

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(June 1, 1934)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb	23.30c.
Antimony, domestic and Chinese (duty paid) lb	8.25c.
Bismuth, ton lots, lb	$1.20
Cadmium, lb	55.00c.
Chromium, 97 per cent grade, lb	88.00c.
Nickel, electrolytic cathodes, lb	35.00c.
Magnesium, 99.8 per cent, carloads, lb	30.00c.
Palladium, troy oz	$23.00
Platinum, troy oz	$36.00
Quicksilver, flask of 76 lb	$75.00@$76.00
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb	$1.80
Silicon, minimum 97 per cent, spot, lb	16.50c
Tellurium, lb	$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent. c.i.f., long ton	$17.00@$18.00
Iron Ore, Lake Superior, long ton:	
Old Range, bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$40.00@$42.50
Manganese Ore, long ton unit:	
52@55 per cent	24c.
49@51 per cent	23c.
44@47 per cent	22c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese, duty paid	$18.75@$19.00
Domestic Scheelite	$18.00@$19.00
Vanadium Ore, per lb. of contained V_2O_5	26c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$27.00

Metallic Compounds

Arsenious Oxide (arsenic) lb	4c.
Cobalt Oxide, 70@71 per cent, lb	$1.35
Copper Sulphate, 100 lb	$3.85
Sodium Nitrate, ex vessel, 100 lb	$1.31½
Sodium Sulphate, bulk, ton	$13.00@$15.00

Alloys

Beryllium-Copper, 12.5 per cent Be, 5! to 200 lb., lb	$3.81
Ferrochrome, 65@70 per cent chromium, 4@6per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$450@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32@$37
Shorts	$11@$15
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$5.00@ $6.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois, 85-5 per cent, ton	$17.00@.....
Fuller's earth, f.o.b. Georgia or Florida, ton	$10.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in	15 @30c.
2x2 in	30 @50c.
2x3 in	50 @65c.
3x4 in	90 @ $1.25
4x6 in	$1.50 @ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$9.00@$12.00
Vermont, extra white, 200 mesh	$8.5@0 $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley, furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets and Sheet bars, gross ton	$29.00
Structural shapes, 100 lb	$1.85
Bars, 100 lb	$1.90

Daily and Average Monthly Prices of Metals

May, 1934

United States Market

May	Electrolytic Copper: Domestic 'Blue Eagle" F.o.b. Valley (a)	Electrolytic Copper: Domestic Basis "Blue Eagle" Refinery (b)	Electrolytic Copper: Export Refinery (c)	Straits Tin New York	Lead: New York	Lead: St. Louis	Zinc St. Louis
1	8.50	8.275	7.950	54.600	4.25	4.10	4.35@4.40
2	8.50	8.275	7.950	54.700	4.25	4.10	4.400
3	8.50	8.275	7.925	54.050	4.25	4.10	4.35@4.40
4	8.50	8.275	7.900	54.000	4.25	4.10	4.35@4.40
5	8.50	8.275	7.875	53.900	4.25	4.10	4.350
7	8.50	8.275	7.850	54.100	4.25	4.10	4.350
8	8.50	8.275	7.825	54.125	4.25	4.10	4.350
9	8.50	8.275	7.850	54.375	4.25	4.10	4.350
10	8.50	8.275	7.950	54.000	4.25	4.10	4.350
11	8.50	8.275	7.975	54.050	4.25	4.10	4.350
12	8.50	8.275	8.075	54.000	4.25	4.10	4.350
14	8.50	8.275	8.075	53.125	4.25	4.10	4.350
15	8.50	8.275	8.025	53.000	4.25	4.10	4.350
16	8.50	8.275	7.975	53.125	4.25	4.10	4.350
17	8.50	8.275	7.950	53.625	4.15	4.00	4.350
18	8.50	8.275	7.950	53.150	4.00	3.85	4.350
19	8.50	8.275	7.925	53.150	4.00	3.85	4.350
21	8.50	8.275	Holiday	53.150	4.00	3.85	4.30@4.35
22	8.50	8.275	7.900	53.300	4.00	3.85	4.350
23	8.50	8.275	7.800	52.875	4.00	3.85	4.350
24	8.50	8.275	7.800	52.750	4.00	3.85	4.30@4.35
25	8.50	8.275	7.825	53.000	4.00	3.85	4.30@4.35
26	8.50	8.275	7.925	53.000	4.00	3.85	4.30@4.35
28	8.50	8.275	7.850	53.150	4.00	3.85	4.30@4.35
29	8.50	8.275	7.900	53.125	4.00	3.85	4.300
30	Holiday		7.875	Holiday			
31	8.50	8.275	7.850	52.650	4.00	3.85	4.300
Av. for month	....	8.275	7.913	53.541	4.140	3.99	4.346
Averages for Week							
2		8.275	8.004	55.013	4.25	4.10	4.396
9		8.275	7.871	54.092	4.25	4.10	4.358
16		8.275	8.013	53.550	4.25	4.10	4.350
23		8.275	7.905	53.208	4.025	3.875	4.346
30		8.275	7.863	53.005	4.000	3.850	4.320
Calendar Week Averages							
5		8.275	7.933	54.425	4.25	4.10	4.379
12		8.275	7.921	54.108	4.25	4.10	4.350
19		8.275	7.983	53.196	4.15	4.00	4.350
26		8.275	7.850	53.013	4.00	3.85	4.333

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery n New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. On foreign business in copper most sellers name a c.i.f. price, usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our f.o.b. refinery quotation.

Note: "Non-Blue Eagle" domestic copper May 1, 7.975c. "Non-Blue Eagle" quotations withdrawn May 2.

Silver, Gold, and Sterling Exchange New York and London

May	Sterling Exchange: "Checks"	Sterling Exchange: "90-day Demand"	Silver (a): New York	Silver (a): London	Gold: London	Gold (b): United States
1	5.12250	5.12500	41.7500	18.1875	135s 11½d	$35.00
2	5.11625	5.11750	42.6250	18.6875	136s 3½d	35.00
3	5.12250	5.12500	42.7500	18.7500	136s	35.00
4	5.11625	5.11875	42.7500	18.6250	135s 10 d	35.00
5	5.11625	5.11875	42.8750	18.7500	136s 2 d	35.00
7	5.11250	5.11500	43.5000	19.0625	136s 2 d	35.00
8	5.10750	5.11000	43.7500	19.1250	136s 1½d	35.00
9	5.12500	5.12750	45.1250	19.8125	135s 11½d	35.00
10	5.11375	5.11500	44.2500	19.1875	136s	35.00
11	5.11250	5.11375	44.2500	19.2500	136s 1 d	35.00
12	5.11500	5.11750	44.6250	19.1250	135s 10 d	35.00
14	5.11000	5.11250	44.6250	19.5000	135s 11½d	35.00
15	5.10750	5.11000	44.5000	19.3125	136s ½d	35.00
16	5.10750	5.11000	44.0000	19.1250	136s	35.00
17	5.11000	5.11250	44.8750	19.6875	136s 1 d	35.00
18	5.11000	5.11250	44.7500	19.3750	136s 2 d	35.00
19	5.10750	5.11000	45.0000	19.5625	136s 2½d	35.00
21	5.10625	5.10875	45.1250	Holiday	Holiday	35.00
22	5.10750	5.11000	45.1250	19.5625	136s 3 d	35.00
23	5.09000	5.09125	44.7500	19.6875	136s 6½d	35.00
24	5.08500	5.08750	44.6250	19.5625	136s 9 d	35.00
25	5.09250	5.09375	44.7500	19.5625	136s 6½d	35.00
26	5.09000	5.09125	44.7500	19.5000	136s 6 d	35.00
28	5.08250	5.08375	44.8750	19.5000	136s 8½d	35.00
29	5.08000	5.08250	45.0000	19.5625	136s 9 d	35.00
30	Holiday			19.5625	137s ½d	Holiday
31	5.06625	5.06875	44.8750	19.5625	136s 11½d	35.00
Av. for month	5.10510	.....	44.226	19.276	.....	35.00
Averages for Week						
2	5.13313	.....	42.667	.....	.....	.....
9	5.11667	.....	43.458	.....	.....	.....
16	5.11104	.....	44.375	.....	.....	.....
23	5.10521	.....	44.938	.....	.....	.....
30	5.08600	.....	44.800	.....	.....	.....

Calendar week averages: New York Silver May 5, 42.583; May 12, 44.250; May 19, 44.625; May 26, 44.854.

(a) Silver not eligible for sale to the U. S. Government. Under Executive order issued Dec. 31, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(b) U. S. Treasury's gold price.

London Market

May	Copper: Standard Spot	Copper: Standard 3M	Copper: Electrolytic Bid	Tin: Spot	Tin: 3M	Lead: Spot	Lead: 3M	Zinc: Spot	Zinc: 3M
1	32.7500	33.0000	35.7500	238.5000	235.5000	11.4375	11.8125	14.8125	15.1250
2	32.8750	33.0625	35.7500	238.5000	236.0000	11.3750	11.6875	14.8125	15.1250
3	32.5625	32.8125	35.6250	233.7500	231.7500	11.3125	11.6875	14.8125	15.1250
4	32.5000	32.6875	35.5000	234.5000	232.2500	11.1875	11.5625	14.7500	15.0625
7	32.2500	32.5000	35.2500	235.3750	232.3750	11.1250	11.5000	14.6875	15.0000
8	32.1875	32.3750	35.2500	235.2500	232.0000	11.0625	11.4375	14.8125	15.1250
9	32.9375	33.1875	35.7500	235.7500	232.5000	11.0625	11.3750	14.9375	15.2500
10	32.9375	33.1875	36.0000	236.5000	232.7500	10.9375	11.2500	14.7500	15.1250
11	33.3750	33.6875	36.5000	236.0000	232.5000	11.0000	11.3125	14.7500	15.1250
14	33.0000	33.3125	36.0000	233.2500	229.7500	10.8750	11.1875	14.6250	14.9375
15	32.8125	33.1250	36.0000	232.5000	228.7500	10.8125	11.1875	14.5000	14.8125
16	32.6250	32.9375	36.0000	232.2500	228.7500	11.0000	11.3125	14.6250	14.9375
17	32.8125	33.1250	36.0000	234.7500	231.2500	10.9375	11.2500	14.6875	14.9375
18	32.8125	33.1250	36.0000	232.5000	229.2500	10.8750	11.1875	14.6250	14.8750
21					Holiday				
22	32.5000	32.6875	35.5000	233.0000	229.7500	10.8750	11.1875	14.6250	14.8125
23	32.2500	32.5000	35.2500	232.6250	229.0000	10.7500	11.0000	14.5000	14 6250
24	32.3125	32.5625	35.2500	232.2500	228.2500	10.8750	11.1250	14.6250	14.7500
25	32.6875	32.9375	35.5000	233.0000	229.5000	11.0000	11.2500	14.7500	14.8750
28	32.5000	32.8125	35.7500	233.7500	229.7500	11.1875	11.3750	14.7500	14.8750
29	32.7500	33.0000	36.0000	234.0000	230.2500	11.1250	11.3125	14.7500	14.9375
30	32.5000	32.8125	36.0000	232.5000	229.7500	11.1250	11.2500	14.8125	14.8750
31	32.6250	32.9375	36.0000	232.7500	229.5000	11.1875	11.2500	14.8750	14.9375
Av for month.	32.662	.....	35.756	234.239	.....	11.051	11.341	14.722	14.966

The United States quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices of domestic class are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted as 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade Zinc delivered in the East and Middle West usually command a pre-

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1933	1934	1933	1934	1933	1934
January	25.400	44.188	16.883	19.382	336.060	504.644
February	26.074	45.233	16.885	20.073	342.114	503.085
March	27.928	45.875	17.588	20.278	343.138	509.259
April	30.730	45.180	18.440	19.740	357.565	515.210
May	34.072	44.226	19.046	19.276	393.106	510.510
June	35.663		19.078		413.216	
July	37.630		18.341		464.760	
August	36.074		17.877		449.944	
September	38.440		18.272		466.240	
October	38.190		18.221		466.380	
November	42.974		18.428		514.573	
December	43.550		18.674		511.260	
Year	34.727		18.144		421.530	

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery — Electrolytic — Domestic		Export	London Spot — Standard		Electrolytic	
	1933	1934	1934	1933	1934	1933	1934
January	4.775	7.890	7.831	28.557	32.560	33.244	35.614
February	4.775	7.777	7.844	28.481	33.072	32.556	35.969
March	5.011	7.775	7.837	28.179	32.497	32.370	35.512
April	5.395	8.173	8.053	29.576	33.006	33.681	36.038
May	6.698	8.275	7.913	34.071	32.662	38.163	35.756
June	7.773			36.759		41.000	
July	8.635			37.917		41.524	
August	8.768			36.071		40.227	
September	8.753			35.122		38.339	
October	7.950			33.656		36.977	
November	7.881			30.588		33.898	
December	7.885			31.306		34.329	
Year	7.025			32.524		36.359	

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1933	1934	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.000	4.000	2.875	3.900	10.458	10.833	11.304	11.517
February	3.000	4.000	2.875	3.900	10.431	10.719	11.634	11.913
March	3.146	4.000	3.021	3.900	10.609	10.821	11.545	11.842
April	3.260	4.179	3.135	4.042	10.872	11.122	11.500	11.794
May	3.654	4.140	3.525	3.990	12.095	12.372	11.051	11.341
June	4.173		4.023		13.280	13.571		
July	4.452		4.303		13.411	13.613		
August	4.500		4.350		12.182	12.457		
September	4.500		4.350		11.932	12.229		
October	4.313		4.176		11.804	12.102		
November	4.288		4.146		11.537	11.778		
December	4.141		4.042		11.431	11.658		
Year	3.869		3.735		11.670	11.940		

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1933	1934	1933	1934
	Straits		Standard, Spot	
January	22.692	51.891	145.708	226.631
February	23.500	51.668	148.544	226.731
March	24.221	53.838	149.120	233.863
April	27.136	55.622	157.944	239.181
May	36.051	53.541	186.207	234.239
June	44.097		219.964	
July	46.356		216.673	
August	44.794		215.210	
September	46.665		216.893	
October	47.858		223.455	
November	53.011		226.722	
December	52.936		227.678	
Year	39.110		194.510	

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1933	1934	1933 Spot	1933 3 Mos.	1934 Spot	1934 3 Mos.
January	3.018	4.271	14.381	14.595	14.688	14.943
February	2.666	4.384	13.866	14.119	14.844	15.125
March	2.987	4.368	14.647	14.674	14.735	15.033
April	3.298	4.370	14.951	15.208	14.916	15.200
May	3.805	4.346	15.505	15.660	14.722	14.966
June	4.348		16.988	16.774		
July	4.878		17.795	17.789		
August	4.916		16.869	17.031		
September	4.699		16.810	17.042		
October	4.748		16.310	16.599		
November	4.520		15.048	15.349		
December	4.461		14.826	15.059		
Year	4.029		15.666	15.825		

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1933	1934	1933	1934
January	55.000	55.000	23.300	23.300
February	55.000	55.000	23.300	23.300
March	55.000	55.000	23.300	23.300
April	55.000	55.000	23.300	23.300
May	55.000	55.000	23.300	23.300
June	55.000		23.300	
July	55.000		23.300	
August	55.000		23.300	
September	55.000		23.300	
October	55.000		23.300	
November	55.000		23.300	
December	55.000		23.300	
Year	55.000		23.300	

Aluminum in cents per pound, 99 per cent grade.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1933	1934	1933	1934	1933	1934
January	5.722	7.198	48.500	67.538	26.480	38.000
February	5.738	7.172	48.614	72.011	24.000	38.000
March	5.901	7.545	52.676	75.472	24.667	38.000
April	5.876	7.918	54.580	75.930	26.800	38.000
May	6.264	8.465	56.500	75.577	28.500	36.538
June	6.500		60.038		30.000	
July	7.262		62.900		32.320	
August	6.986		63.500		33.000	
September	6.880		64.580		34.560	
October	6.843		66.500		36.000	
November	7.113		66.000		37.583	
December	7.250		66.330		38.000	
Year	6.528		59.227		30.993	

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1933	1934	1933	1934	1933	1934
January	14.50	18.00	14.00	17.00	14.50	17.50
February	14.50	18.00	14.00	17.00	14.50	17.50
March	14.50	18.00	14.00	17.00	14.50	17.50
April	14.50	18.48	14.00	17.48	14.50	17.98
May	15.42	19.00	14.42	18.00	14.92	18.50
June	16.00		15.00		15.50	
July	16.50		15.50		16.00	
August	17.00		16.00		16.50	
September	18.00		17.00		17.50	
October	18.00		17.00		17.50	
November	18.00		17.00		17.50	
December	18.00		17.00		17.50	
Year	16.24		15.41		15.91	

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces

mium of 1c. over Prime Western zinc.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

New York silver quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, 925 fine. Sterling prices represent noon market demand.